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Source Document: The Relationship Between Pocket Gophers (Thomomys bottae) and the Distribution of Buried Radioactive Waste at the Los Alamos National Laboratory

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Edited by Hector Hinojosa, Group CIC-1
Prepared by Teresa Hiteman, Group ESH-20

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G. J. Gonzales[1]
R. L. Budd[2]
P. R. Fresquez[1]
R. J. Wechsler[1]

[1]*Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545. Send correspondence to G. J. Gonzales, Mail Stop M887, Ecology Group (ESH-20), or email gonzales_g@lanl.gov.*
[2]*Colorado State University, Fort Collins, CO.*

Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545

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ABSTRACT

Material Disposal Area G at the Los Alamos National Laboratory is a low-level radioactive waste storage facility. The noticeable presence of pocket gopher mounds and cast soil on closed waste burial sites of various types resulted in the need to understand possible interactions between gophers and radioactive waste at Area G. In our study, pocket gophers, mound soil, off-mound surface soil, and vegetation were collected at Area G and at off-site background locations. The samples were analyzed for ^{241}Am, ^{238}Pu, ^{239}Pu, ^{3}H, and total U. A comparison of radionuclide concentrations in mound soil to surface soil and in gophers to soil and vegetation implied that gopher activity is generally not resulting in the upward transport of radionuclides. Concentrations of ^{241}Am, ^{238}Pu, ^{239}Pu, and ^{3}H in some of the gopher, soil, and vegetation samples were higher than background at some of the sites, however, gophers at only one site within Area G had ^{3}H concentrations that resulted in an estimated dose to gophers that could impact their health. Relationships in radionuclide concentrations between the four media (pocket gophers, mound soil, off-mound surface soil, and vegetation) were examined by conducting correlation tests. Correlations were highest for Am^{241} and ^{238}Pu, however, only the ^{238}Pu relationship may be accurate enough to be used in predicting concentrations. The relationship in radionuclide concentration between pelts and carcasses was highly variable—carcasses, including the gastrointestinal tract, contained between 51% and 575% of the radionuclide concentration on pelts. Data generated by this study are valuable for ecological risk assessments. Further investigation through modeling and monitoring may be necessary to determine if the ^{3}H shafts are a source of environmental ^{3}H levels that are of ecological concern. Future research should include modeling the transport of radionuclides through ecological receptors within and around Area G. This should include investigations of transfer to high-level carnivores, especially raptors.

1.0 Introduction

Waste site covers at nuclear facilities are intended to keep the waste immobile, minimize exposure of the waste to the surrounding ecosystem, and protect the waste from environmental elements such as precipitation and soil erosion. Currently waste covers are designed with the intent of enduring up to 10,000 years of use. However, physical, chemical, and biological forces can compromise the integrity of waste covers. There has always been a concern that biological processes have the potential to redistribute buried waste, which can then enter into biological pathways.

Burrowing animals can compromise the integrity of waste covers by excavating soil from the cover, increasing water infiltration rates into the soil and waste cells beneath soil covers, increasing soil erosion, and penetrating into waste cells and mobilizing radionuclides (O'Farrell et al., 1972; Hakonson et al., 1982). Radioactive contamination has been detected above waste burial sites in soil brought to the surface by burrowing animals (Shuman and Whicker, 1986) and in feces and bone fragments of fossorial animals (O'Farrell and Gilbert, 1975). Animals foraging around waste burial sites have been contaminated with various radionuclides (Smith and Bernhardt, 1977; Miera and Hakonson, 1978; Garten, 1979).

Material Disposal Area G (Area G) at the Los Alamos National Laboratory (LANL) in New Mexico (Figure 1) is a low-level radioactive waste (LLW) storage and disposal facility. Area G was opened in 1957 as a repository for radioactive waste produced by LANL. Radioactive isotopes historically present in waste produced by LANL include tritium (^{3}H), many transuranic (TRU) radioisotopes such as plutonium (Pu), uranium (U), and americium (Am), and other fission and activation byproducts. The primary waste storage and disposal units include disposal pits, shafts, and waste trenches.

Pocket gophers (*Thomomys bottae*) have the ability to burrow to the depth of the older, more shallow waste cells at Area G. The noticeably large amount of pocket gopher soil mounds and cast soil on closed waste burial sites resulted in the need to understand possible interaction by gophers with buried waste at Area G.

A field study was designed to investigate the dynamics between pocket gopher activity and radionuclide concentrations and distribution, including the consideration of the environmental parameters that affect soils and the uptake of radionuclides. Five treatment sites were identified at Area G and compared with a composite of three control sites well outside the boundaries of LANL. Pocket gophers, cast soil, surface soil, and vegetation were collected and analyzed for: ^{3}H, ^{238}Pu, ^{239}Pu, and ^{241}Am; and total U. Total U consists mostly of ^{238}U (~99.7%), a stable, non-radioactive isotope, and about 0.3% ^{235}U, a radioactive isotope.

The following hypotheses were tested in this study:

- H1: There is no significant difference between radionuclide concentrations in mound soil and off-mound soil.
- H2: There is no significant difference between radionuclide concentrations in carcass and off-mound soil.
- H3: Radiation dose to gophers does not exceed an ecological screening level of 0.1 rad/day.
- H4: There is no statistical relationship in radionuclide concentrations between pocket gophers, cast soil, and vegetation.

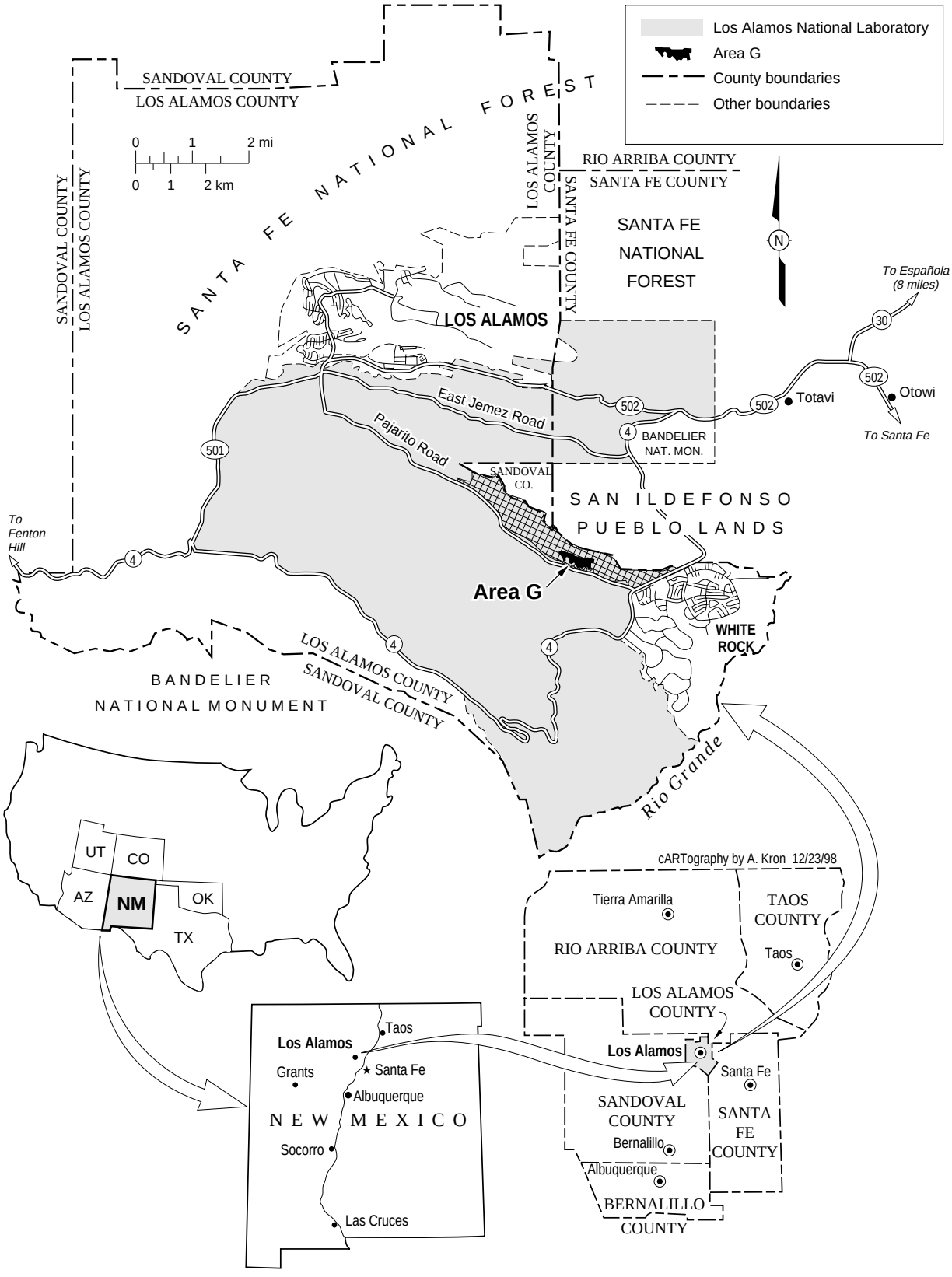


Figure 1. Location of Area G at Los Alamos National Laboratory

- H5: Mean radionuclide concentrations in pocket gopher whole body carcasses are the same between study sites.
- H6: Mean radionuclide concentrations in cast soil are the same between study sites.
- H7: Mean radionuclide concentrations in vegetation are the same between study sites.

The results of this study will be used to evaluate the effect of gopher burrowing on waste isolation at Area G. This study will give waste managers a better understanding of the interaction between pocket gophers and buried waste at this and other waste management facilities. This information will help managers at Area G make decisions on managing waste and gophers such that risk to humans and non-humans from radionuclides is minimized. The resulting data can also be used in ecological risk assessments.

2.0 Literature Review

2.1 General

2.1.1 Pocket Gopher Ecology

There are three primary genera of pocket gophers in the family Geomydae occupying the Western Hemisphere: *Thomomys, Geomys,* and *Papageomys* (Chase et al., 1982; USDA, 1996). Pocket gophers are allopatric in distribution, and two species rarely occupy the same area. Once a territory has been established, only minor shifts in a pocket gopher's location will occur (Chase et al., 1982). The genera are distinguished from one another by a central groove in the front incisors: *Papageomys* has one, *Geomys* has two, and *Thomomys* is lacking any groove (USDA, 1996). The pocket gophers occupying the area within the study site of this report were identified as *Thomomys bottae* based on the lack of a central groove in the incisors.

Pocket gophers have a fur-lined mouth that is capable of closing completely behind the incisors, which enables the use of the incisors for digging without soil entering the mouth. The term pocket gopher stems from the pouches, or pockets, on each side of the mouth that are used to carry food and can be turned inside out to retrieve the contents. Pocket gophers are opportunistic herbivores and consume forbs, grasses, shrubs, and trees. *Thomomys* species prefer perennial forbs (Case and Jasch, 1994).

Pocket gophers are solitary individuals, except during mating season and during time of rearing young. Although *Thomomys* may breed throughout the year, the main mating season is during the spring, birthing occurs in the summer, and juveniles seek new territory in the late summer and fall (Case and Jasch, 1994; Chase et al., 1982). *Thomomys* reach sexual maturity at about one year of age and live approximately five years (Chase et al., 1982). Litters range from 1 to 12 and average between 3 and 6 (Case and Jasch, 1994; USDA, 1996).

Population densities normally are between 6.5 and 8 per hectare, but can reach as high as 25 per hectare. The population density is mainly determined by environmental factors. Most pocket gophers prefer light-textured soils with good vegetation production. Because pocket gophers maintain a closed-burrow system, exchange of atmospheric gases through the soil is critical (Case and Jasch, 1994). Also, good soil drainage is necessary to prevent flooding of the system (Chase et al., 1982).

Several predators feed on pocket gophers, including coyote (*Canis latrans*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), weasel (*Mustela* spp.), fox (*Urocyon cineroargenteus, Vulpes vulpes*), skunk (*Mephitis mephitis*), gopher snake (*Pituophis melanoleucus),* and several species of owl (*Bubo, Otus,* and *Strix* spp.) and hawk

(*Accipiter*, *Aquila*, and *Buteo* spp.). Predation usually occurs during periods of mound formation, surfacing to forage for food, movement of gophers from one burrow system to another, snowmelt, flood irrigation, or interaction with a more aggressive gopher in which the gopher must leave the security of the burrow system. However, some predators are capable of digging into the system (Chase et al., 1982).

Pocket gophers excavate a system of burrows by loosening the soil with their front claws and incisors, then pushing the soil out of the burrow using the chest and forefeet (Case and Jasch, 1994). Mounds, earth plugs, and winter soil casts are three recognizable signs of pocket gopher activity. Mounds are piles of soil that have been pushed to the soil surface during excavation of burrows and are approximately 36 to 60 cm wide and 15 cm high (USDA, 1996). Earth plugs are formed when the entrance of a tunnel is blocked with loosened soil after a gopher has surfaced to forage for food (Chase et al., 1982). Winter soil casts are formed during periods of snowfall when soil is removed from underground systems and deposited into tunnels formed in the snow. The tunnels remain on top of the ground after the snow melts and until the first heavy rainfall (USDA, 1996).

An individual gopher may produce as many as 300 mounds per year, at an estimated mass of 2.25 Mg of soil annually (Case and Jasch, 1994). Hakonson et al. (1982) observed an excavation rate of five mounds per day per hectare formed by *Thomomys bottae* at Area G, or an average excavation rate of about 30 kg soil per day per hectare. This rate of excavation corresponds to approximately 12 Mg of soil being excavated over waste covers per year at LANL (Hakonson and Gladney, 1981).

Pocket gophers have the ability to move fairly large rocks out of the tunnel while excavating. Hakonson et al. (1982) observed that mounds formed over a waste trench at Area G consisted primarily of crushed tuff that had been located approximately 0.25 m below the topsoil. One third of the soil brought to the surface was gravel and cobble size of greater than 2 mm, and the remaining two thirds was less than 2 mm (Hakonson et al., 1982).

A pocket gopher's burrow system usually consists of a main tunnel with many branching side tunnels that are used for foraging (USDA, 1996). The territory, or home range, of a pocket gopher can range from 10 to 75 m^2, with up to 180 m of tunnel system (Cantor and Whitham, 1989). These tunnels are approximately 10 to 46 cm below ground, depending on the soil texture (Case and Jasch, 1994). A deeper tunnel system is usually used for nesting, food storage, defecation, and extra soil deposits (USDA, 1996). The deeper systems range from approximately 0.5 to 1.5 m in depth (USDA, 1996; Chase et al., 1982).

2.1.2 Effect of Burrowing on Soil Characteristics and Erosion

There has been much debate concerning the effect of burrowing activities on the erodibility of surface soils. Burrowing can facilitate erosion of soil by wind and surface water by loosening the soil, making the soil subject to those processes. The possibility of redistribution of surface soil contaminants increases as soil erosion increases. For example, excavated soil at Niwot Ridge, CO, contained less moisture, had a lower bulk density, and was more susceptible to wind erosion than undisturbed soil (Litaor et al., 1996). Since surface-deposited radionuclides have been measured downwind from the Department of Energy's (DOE's) Rocky Flats Plant in Colorado (Little et al., 1980; Ibrahim et al., 1996) and the Trinity Site at the White Sands Missile

Range in southern New Mexico (Hakonson and Nyhan, 1980), it is important to identify any process or activity that facilitates the aerial suspension of contamination. Whicker and Shultz (1982) speculated that burrowing activities played a role in increasing wind resuspension and deposition in the former study, however, further research is necessary to test this concept. Mound building has been cited for potentially increasing the movement of nutrients (Litaor et al., 1996) and sediments (Black and Montgomery, 1991) offsite through overland flow, which would also affect the movement of any associated contaminants.

Hakonson (1999) studied the effects of gopher burrowing activities on surface water runoff and erosion under the same experimental design described in Section 2.5 for a study by Gonzales et al. (1995). Erosion from vegetated plots and plots covered with gopher mounds was less than the erosion from bare plots. Vegetation on a plot reduced erosion by 12% compared to bare plots, and gopher mounds decreased erosion by 21% when compared to bare plots (Hakonson, 1999). However, Gonzales et al. (1995) point out that the latter potentially occurs at the expense of increased channeling of water into the waste cell zone through gopher burrows. Because radionuclides have a capacity to bind to the silt-clay fraction, erosion of these particles has been inferred as the primary transport mechanism for surface-deposited radionuclides that are susceptible to erosion forces (Gonzales et al., 1995).

The void created by tunnel systems can increase the rate of water infiltration into soils (Grinnel, 1923). Infiltration in soils with burrowing activity can be as much as twice that over undisturbed land (Hakonson and Gladney, 1981). Hakonson (1999) also concluded that mound formation increased water and contaminant movement through the soil profile.

2.2 Burrowing Over Waste Trenches

Burrowing animals are attracted by the disturbed soils covering waste trenches. Trench walls serve as lateral edges that are sought by burrowing animals, possibly for the increase in diversity of plant species typical of edge habitats (Boone and Keller, 1993). Covers of asphalt or concrete provide a weatherproof top for den and feeding chambers of some species (Smallwood et al., 1998), however, other species such as gophers rely on covers of soil. Burrow depth has been reported to increase over disturbed waste sites for various rodents such as deer mice (*Peromyscus maniculatus*) and montane voles (*Microtus montanus*) (Landeen and Mitchell, 1981; Reynolds and Laundre, 1988).

2.3 Vegetation and Burrowing Animal Interactions

Plants on waste covers are used to control soil erosion and, through root uptake, reduce leaching to groundwater. The roots of some deep-rooted plant species common to LLW sites can penetrate into the protective covers. Several plant intrusion studies have been conducted under the uranium mill tailings remedial action project and at LANL. The studies displayed the intrusion of roots of several plant species through various types of protective barriers, some of which reached depths of 2.4 m (Bowerman and Redente, 1998).

Shuman (1999) attempted to model potential impacts of animal activity and vegetation on contamination on the surface at Area G. Animal burrowing and vegetation might have opposing effects in depositing contamination on the soil surface, depending on environmental factors such as plant uptake for individual elements, soil cover

depth, and plant community type. Litter deposited on the surface could potentially contain contamination for elements with high plant uptake. Burrowing activities would dilute the concentrations found in the litter with soil brought to the surface containing relatively low concentrations. Vegetation has a much stronger influence on covers with deeper soil depths and older plant succession. Burrowing activity would have a larger influence for elements with low (below 0.1) plant uptake factors, while the vegetation would deposit relatively contaminant-free litter, therefore lowering the overall surface concentration (Shuman, 1999). As will be discussed later, the actinide elements Am, Pu, and total U have plant uptake factors less than 0.1, and upward transport would therefore be most sensitive to the activity of burrowing animals.

2.4 Movement of Radionuclides

2.4.1 Uptake Through Foraging

Several monitoring programs have shown radionuclide concentrations greater than background concentrations in wildlife surrounding some contaminated waste sites. Cotton rats (*Sigmodon hispidus*) foraging near a radioactive waste pond at Oak Ridge National Laboratory contained an increased body burden of radiocesium compared to a control group (Garten, 1979). A study at LANL found increased concentrations of cesium (Cs) in rodents inhabiting an area surrounding an effluent discharge pipe. Concentrations of radionuclides varied with rodent species (Miera and Hakonson, 1978). Smith and Bernhardt (1977) conducted a three-year grazing study at the Nevada Test Site and found that actinide concentrations in cattle foraging on the Pu-contaminated range remained relatively constant, and cattle born on the study range showed a trend of increased actinide body burden with time (Smith and Bernhardt, 1977).

A study comparing model estimate and measured radionuclide tissue concentrations in mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus nelsoni*) that forage around Area G was conducted using sampling information from 1993–1996. Both actual and predicted tissue concentrations were well below environmental guidelines for radionuclides (Ferenbaugh et al., 1999). This is an indication that, although there may be elevated radionuclide concentrations in the media immediately surrounding a source of contamination, the risk of offsite transport through environmental media to wildlife residing offsite is minimal.

2.4.2 Exposure Through Predation

Radionuclides can be dispersed through contaminated feces or from the movement of predators who feed on contaminated prey. A study of a waste trench that was exposed by burrowing activity at the Hanford Site found both these mechanisms to be important vectors in transporting waste. Contaminated coyote feces were found 3.2 km away from the site, which contained what appeared to be pocket gopher bones. There were several jackrabbit (*Lepus* spp.) bone fragments found 9.7 km away from the site (O'Farrell and Gilbert, 1975). Coyote fecal samples surrounding a radionuclide waste leaching pad at the Idaho National Engineering and Environmental Laboratory (INEEL) were also found to have elevated radionuclide concentrations (Arthur and Markham, 1982). Nesting raptors surrounding INEEL were found to have higher concentrations and a larger variety of radionuclides than at control sites. The concentrations in the raptors surrounding INEEL were lower than potential prey concentrations captured within the INEEL

boundary, suggesting raptor concentrations were diluted by feeding on uncontaminated prey found outside INEEL territory (Craig et al., 1979). Mason and MacDonald (1988) found elevated levels of radiation in otter (*Lutra lutra*) scat in northwestern Britain and Wales following the 1986 Chernobyl nuclear power plant accident. The scat was compared against a control site and pre-accident data. The authors theorized that the elevated levels were obtained from contaminated fish, the main food source for otters. These studies show the potential for transfer of radionuclides through food chains and spread into ecosystems.

2.5 Effect of Burrowing on the Distribution of Contaminants

Some experimental research has been conducted to determine the effects of burrowing activities on the distribution of radionuclides. A two-year study conducted by Gonzales et al. (1995) involved three treatment plots and one control plot. The treatment plots included one bare plot serving as the control, one seeded with vegetation, one with an introduced pocket gopher (*Thomomys bottae*), and one with vegetation and an introduced pocket gopher. Dissolved ^{133}Cs was spread over each plot using a rainfall simulator. Among other dependent variables, the rate of contaminant surface water runoff on the inclined plots was measured. They found that both vegetation and pocket gopher activity decreased contaminant runoff. The majority of contaminant was adsorbed to the silt clay fraction, and therefore the erosion of these particles was responsible for most of the ^{133}Cs transport. They concluded that both vegetation and burrowing activities increased surface contaminant infiltration into the soil with vegetation retaining more of the contaminant (radionuclide) in the rhizosphere region while burrowing activity increased transport to greater depths (Gonzales et al., 1995). The retention of radionuclides in the root zone may have been caused by the deposition of Cs at the root zone when disassociation occurred during the uptake of water by plant roots.

Mound formation has been found to redistribute surface-deposited radionuclides within the soil strata. In a study of blow-sand mounds at the Nevada Test Site and Tonopah Test Range in south-central Nevada, mounds created by animal burrowing had a greater vertical distribution of radionuclides than mounds caused by accumulation of wind blown particles (Essington et al., 1977).

Only one article was found that directly links burrowing animals to buried waste (O'Farrell and Gilbert, 1975), but several studies have generated indirect evidence of animals burrowing into buried waste. A back-filled waste trench at the Hanford Site showed signs of burrowing activity that exposed a contaminated salt cake. Feces that were found scattered around the site were analyzed and had elevated concentrations of radionuclides, indicating wildlife had been exposed to the radionuclides (O'Farrell and Gilbert, 1975).

Several studies have shown that fossorial animals have burrowed in contaminated soil and either transported contaminants to the surface or have become contaminated themselves (Arthur et al., 1987; Smallwood, 1996; Halford, 1987). A study conducted at INEEL found higher than background radionuclide tissue concentrations in deer mice (Arthur et al., 1987). A second study conducted by the same authors found elevated radiation doses to both deer mice and kangaroo rats (*Dipodomys ordii*), with the highest doses occurring during the winter months when underground activity was greatest (Arthur et al., 1986). This suggests contamination

occurred from contact with subsurface contaminated soil or waste. A pocket gopher sampled at Hanford was found to have strontium ($^{89/90}$Sr) concentrations three orders of magnitude higher than surrounding soils (Smallwood, 1996). Halford (1987) found above-background concentrations of radionuclides in various small mammals at INEEL. The horizontal movement of these mammals was up to 201 m, displaying the potential for movement of small amounts of radionuclides offsite (Halford, 1987). At LANL in December 1999, contaminated soil was discovered at the surface of a TRU waste shaft. Soil mixed with "yellow cake" (precipitate that is formed in the milling of U ores) that was apparently brought to the surface by a pocket gopher contained between 2.3 and 71.6 mg total U/kg soil (0.8 to 23.9 pCi/g) (Lopez 2000). The total U concentrations ($\bar{\chi}$ = 10.5 mg/kg) are at least two orders of magnitude lower than the conservative safe limit used in ecological risk screening for chemical effects for a rodent with similar diet. The mean radioactivity (3.5 pCi/g) is four or five orders of magnitude lower than the safe limit for ^{235}U or ^{238}U for similar animals.

There appear to be several important factors involved with whether burrowing activity is deep enough to penetrate waste covers, including environmental factors such as soil texture, pH, time of residence, age of waste site, and species differences. Pu and Am concentrations in soil samples excavated by small mammals at INEEL were significantly greater than surface or control soil (Arthur and Markham, 1983). In a study of pocket gopher activity over a LLW site at LANL, there were no samples with gamma-emitting radionuclide levels above global fallout levels, suggesting pocket gophers had not penetrated the waste trench in the four years of its existence (Hakonson et al., 1982). A comparison study between an experimental tailings reclamation plot located in southeastern Wyoming and a buried mill tailing plot in Grand Junction, CO, found significantly higher than background concentrations of radionuclides in mound soil over the Grand Junction site but not the Wyoming site. The authors concluded that intrusion from burrowing into the tailings layer had occurred for the Colorado site. The Colorado site was an older established site with finer texture soil and neutral pH tailings while the Wyoming site was a newer reclamation plot with sandy, acidic mill tailings (Shuman and Whicker, 1986).

2.6 Radiation Ecotoxicology

There is some evidence that the chemical effects of actinide elements are greater than the radiation effects and that non-radionuclides pose a greater risk to non-human biota than radionuclides.

The effect of radiation exposure on ecosystems is complex and variable. Although the life span of a species may be shortened by 10% if the radiation dose is more than one-half of the $LD_{50/30}$ dose, effects on reproduction and fertility are the primary concern at the population and community level (French, 1965). In a study of free-ranging pocket mice (*Perognathus parvus*), all mice exposed to 675 rad or higher became permanently sterile after three breeding seasons (O'Farrell et al., 1972). A range of 1.1–2.2 rad has been shown to be harmful to mice, rats, and guinea pig (*Cavia* spp.) fetuses (Eisler, 1994). On the other extreme, Polynesian rats (*Rattus exulans*) exposed to thousands of roentgens after four separate nuclear detonations have survived and repopulated quickly after each contamination (French, 1965). The variability of population response to chronic radiation exposure depends greatly on species sensitivity and

radiation dose and quality. The ability to determine effects of radiation on pocket gopher populations is beyond the scope of this project. The main concern is over the potential for gophers to introduce radionuclides into food chains and the surrounding ecosystem.

3.0 Study Site

3.1 General

Area G is a waste disposal site located at Technical Area (TA) 54 at LANL in Los Alamos, New Mexico (Figure 1). The area encompasses 25 ha of fenced land to the north of Pajarito Road and east of Mesita del Buey (LANL, 1990). The site was opened in 1957, primarily to dispose LLW. Detailed records describing waste disposal at Area G between 1957 and 1970 are unavailable. This waste has been characterized by extrapolating data for wastes disposed after 1971. The primary radionuclides disposed at Area G are ^{3}H, total U, and various fission and activation products. Approximately 50,000 to 70,000 Ci of ^{3}H have been buried annually since the mid-1980s. Asbestos and polychlorinated biphenyls (PCBs) have also been buried at this site (LANL, 1990).

3.2 Climate and Physical Characteristics

Area G sits atop Mesita del Buey, one of many mesas in the area. Mesita del Buey is surrounded by Cañada del Buey to the north and Pajarito Canyon to the south. The mesa is composed of Bandelier Tuff, which is a series of volcanic ash flows that originated in the Valles Caldera located to the west of LANL. The surrounding area supports piñon-juniper woodland, although relatively few trees currently inhabit Area G. The average precipitation is 36 cm per year, 40% of this occurring during brief intense thunderstorms in July through August. Snowfall is greatest from December to March. The predominant wind direction is from the south-southwest although a more easterly wind is common at night. The average summer daytime temperature ranges from 21° to 32°C (70° to 90°F), with the nighttime temperatures dropping to 10° to 15°C (50° to 59°F). Winter daytime temperatures range from -1° to 10°C (30°to 59°F) and nighttime between -9° to -4°C (16° to 25°F) (Usner, 1996).

Predominant surface water runoff coincides with summer thunderstorms. Erosion as a result of sheet wash has been estimated at 4.0×10^{-5} cm/yr, which would correspond to 1 m of backfill being eroded every one million years. The depth to the local aquifer is approximately 274 m below the mesa top. There are no perennial streams within Area G (LANL, 1997).

3.3 Waste Burial Sites

As of 1997 there are four above-grade TRU waste storage pads, 34 disposal pits, 174 disposal shafts, four below-grade TRU waste trenches, numerous waste storage domes, a liquid waste sump, a septic tank leach field, and a solid waste compactor within the boundaries of Area G. Figure 2 depicts a waste disposal pit and disposal shaft with associated coverings. The disposal pits vary in size but are generally 61 m by 18 m (200 by 59 ft) and approximately 18 m (59 m) deep. Only three of the disposal pits are active at present. The rest have been closed and covered with crushed Bandelier Tuff, the volcanic soil series common to the area. Crushed tuff has recently been identified as an ineffective barrier to both vegetation and animal intrusion (Bowerman and Redente, 1998). The below-grade TRU waste trenches are between 61 and 91 m (200 and 300 ft) long, 4 m (13 ft) wide, and 1.8 m (6 ft) deep. All trenches are closed and covered with crushed tuff. The waste cells of the trenches are covered with Q-Decking, which is corrugated metal that forms an air

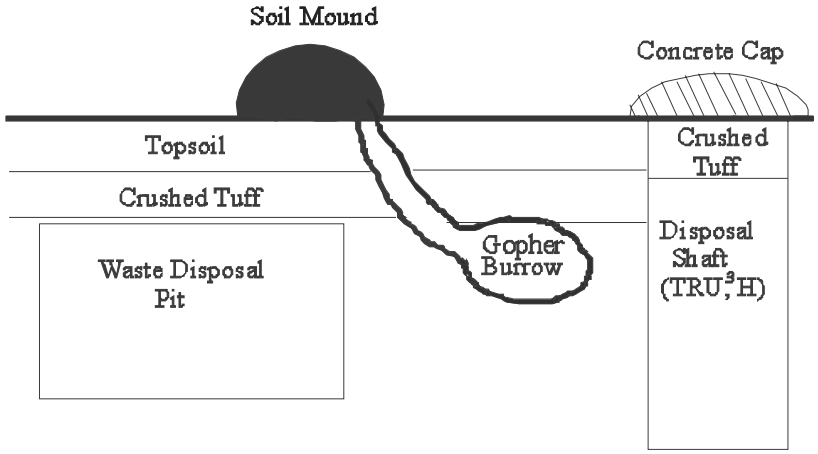


Figure 2: Schematic of waste cells and gopher burrows

space above the radionuclide casks (Rogers, 1977). As can be seen in Appendix A, Table A-1, the depth of the topsoil and tuff originally placed on top of the disposal pits and waste trenches varies but rarely exceeded 1 m deep. Disposal shafts are usually between 0.9 and 1.8 m (~ 3 and 6 ft) in diameter and 5.5 m (18 ft) deep. Early (pre-1970) ^{3}H disposal shafts have no engineering controls except a domed concrete cap to maintain the contaminants in place. Shafts designed after 1970 are lined with a 30-cm-diameter metal casing enclosed by cement and capped with a 0.9-m- (3-ft-) thick domed cement cap, which serves as a more effective barrier to biological intrusion (LANL, 1997).

Disposal shafts used for disposing TRU waste or ^{3}H can be unlined or lined with a metal casing. There are too many shafts within Area G to detail each. Those built after 1971 generally are lined and those built before are usually unlined. The waste disposal pits are unlined as well. Even in lined shafts, ^{3}H has the potential to emanate from the cell. As depicted in Figure 2, burrowing animals such as the pocket gopher can burrow close to disposal pits and possibly interact with waste, however, this is not likely given the depth of most waste cells compared to depths of gopher burrows.

4.0 Methods and Materials

4.1 Preliminary Work

Several mandatory environment, safety, health, and other requirements were met before the sampling phase of this study. The hazard control plan/operating procedure (HCP/OP) entitled "Rodent Trapping at Area G, TA-54" (LANL-ESH-20-HCP/OP-BIO-035, R0; Bennett and Gonzales, 1998) was revised to include trapping of pocket gophers using Victor® pinch traps. An excavation/soil disturbance permit (98X-0240-54) was obtained before soil or gopher collection. This permit resulted from reviews for issues related to the National Environmental Policy Act, electrical utility safety, solid waste management unit safety, and cultural resources. Approval to collect samples on U.S. Forest Service land in the Jemez Mountains was obtained from the Jemez Ranger District. All members of the sampling crew were certified in cardiopulmonary resuscitation, first aide, "Radiological Worker I and II," and TA-54 onsite work. Other training included the HCP/OPs entitled "General Field Work"

(LANL-ESH-20-HCP/OP-001, R0; Biggs, 1998) and "Sampling and Processing of Samples for Waste-Site Monitoring Program" (LANL-ESH-20-HCP/OP-SF-011, R0; Fresquez, 1999a).

Approval from the LANL Institutional Animal Care and Use Committee (IACUC) for the handling and trapping of the gophers was required. We first attempted to live trap gophers using Sherman™ traps because of humane concerns by the IACUC. After this method proved unsuccessful, the IACUC approved pinch trapping. We conducted an observational survey to determine the effectiveness of the pinch traps, which was reported to the IACUC committee. Ten per cent of pinch-trapped gophers were found alive. An additional 13% of the traps were found to have been pulled back into the tunnel system, indicating death was not immediate. The gophers that were alive at time of capture were euthanized using Halothane®.

4.2 Study Sites

Five study sites at TA-54 (Area G) and three control sites were chosen for this study (Figure 3). The study sites were chosen based on their proximity to potential release sites (PRSs) consisting of buried legacy LLW. Study Sites 1 and 3 were broken into A and B sub-sites because of potential differences in contamination sources. Study Site 1A (8.1×10^{-2} ha) surrounds several TRU waste shafts located along the northern fence. Study Site 1B (1.7×10^{-2} ha) is less than 12 m to the south of Site 1A, located adjacent to TRU waste shafts and Disposal Pit 6. Also, contaminated topsoil that was spread over Pit 6 could potentially have been spread to this area as well. Study Site 2 (0.4 ha) was located in the center of Area G in a field over Disposal Pits 17, 18, and 20. Study Site 3A (9.5×10^{-2} ha) was situated along the southeastern fence above TRU Waste Trenches 54-A and 54-B. Two old (pre-1970) waste shafts are also located here. Study Site 3B (2.9×10^{-2} ha) surrounded an old ^{3}H shaft field approximately 15 m north of Study Site 3A along the southeastern fence. All study sites were flagged and mapped using a geographic positioning system (GPS) unit (Figure 3).

The three control sites were chosen at distances and directions from LANL that we believe are not affected by buried legacy contamination. Control Site 1 was located in White Rock, approximately 2.8 km southeast from Area G and had an area of 0.195 ha. Control Site 2 was located approximately 42.7 km to the southwest in the Jemez Mountains of the Santa Fe National Forest and occupied approximately 1.18 ha. Control Site 3 was located in Sombrillo, NM, approximately 24.4 km northeast of Area G, and measured 0.94 ha. The areas were flagged and surveyed using a GPS unit.

4.3 Waste Characteristics of Study Plots

A generalized summary of the historic waste buried at each treatment site is presented in Table 1 (Rogers, 1977; Shuman, 1999). Table A-1 contains more detailed information on the characteristics of waste buried at each study site. The information for Site 1A is presented as a range of values. Only an incomplete database of the content of the TRU waste shafts within Study Site 1A exists. The information for Site 1B is split into shaft and pit information. The shafts are located immediately adjacent to the study site. Pits 6 and 7 are located within 10 m of the study site. Not only are the disposal pits and TRU waste shafts a hypothetical source of exposure to biota, but topsoil that was placed on top of the disposal pits and

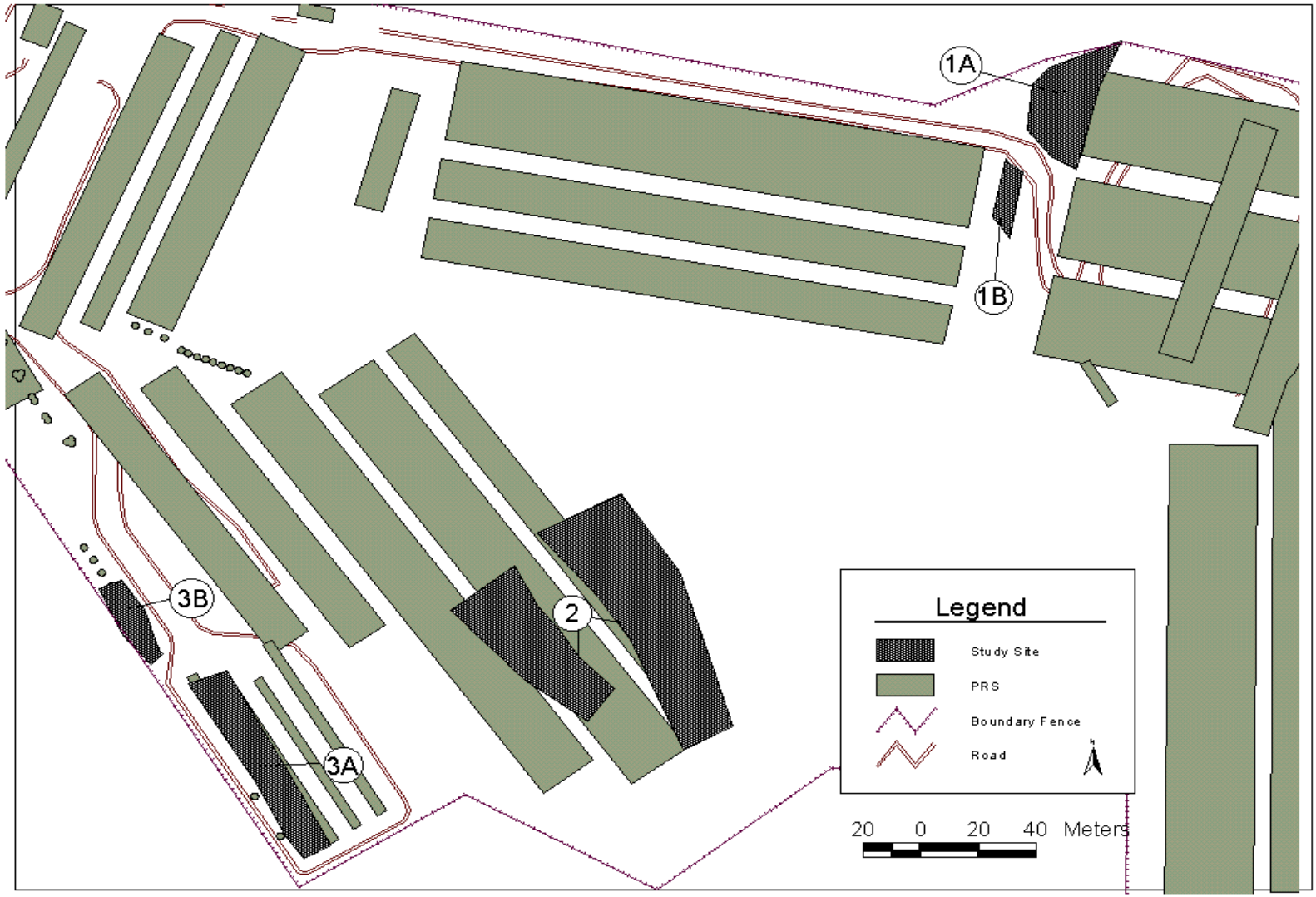


Figure 3: Study Sites at Area G

Table 1: General Description of Study Site Waste Characteristics

Study Site	Dates of Operation		Volume (m^3)	Activity Range (Ci)	Radionuclides	Cover Depth
1A	Sept 1960–Dec 1984		0.02 – 45.37	1.02×10^{-3} – 1000	Am-241, H-3, Pu-238/239, U-232, 233,235,238	0.9 m crushed tuff, 0.5 m concrete
1B	Shafts	Jan 1970–Sept 1978	3,279	80.4	Am-241, Pu-238/239, U-235	0.9 m crushed tuff, 0.1 m topsoil
	Pits	Nov 1969–May 1993	9.242	56,000	H-3, Pu-238/239, U-235/238	0.9 m crushed tuff, 0.5 m concrete
2	Aug 1972–Oct 1979		24.76	30,006	Am-241, H-3, Pu-238–242, U-234–238	0.9 m crushed tuff, 0.1 m topsoil
3A	Mar 1974–Sept 1976		225.96	68,900	Pu 238/239, U 233	Cask lid sealed with asphalt, corrugated "Q-decking" covered with 1 m crushed tuff
3B	Jan 1971–Dec 1995		1.94 m^3	12.3×10^5	H-3	0.9 m crushed tuff, 0.5 m concrete

immediate area in 1976 may have been a small source, i.e., "On June 12, 1976, 'top soil' from TA-1 was spread over Pit 6 [and 7]. This soil had traces of Pu. Group H-8 analyses showed 38 samples with no detectable contamination and 2 samples with 20 pCi/g" (Rogers, 1977). "Subsequent (1997) analyses by ESH-19 indicated ^{239}Pu at 226 pCi/g and ^{241}Am at 166 pCi/g. Concentrations of ^{238}Pu were generally 30 to 40 times lower than those for ^{239}Pu" (Conrad, 1997).

4.4 Gopher Population Density

To estimate gopher population density, a 48-h mound count method was conducted following a procedure described by Reid et al. (1966). There have been several studies that have attempted to use this method to estimate population (Engeman et al., 1993; Anthony and Barnes, 1982; Reid et al., 1966). Reid et al. (1966) provided detailed information on the relationship between fresh sign and gopher density. The technique was generally as follows. All mounds were flattened within the study area. Forty-eight hours later the presence of fresh soil mounds were recorded. A comparative regression analysis was used to estimate gopher population density of each site from the number of new mounds.

4.5 Soil Sample Collection

Three sets of three soil samples were collected at each Area G study site, totaling nine soil samples per site. Three samples were collected from each of the three control sites.

For the Area G samples, the first set of samples consisted of soil from three pocket gopher mounds. The mounds that appeared to be most recent were selected in order to minimize the amount of time during which wind or precipitation could influence the radionuclide concentration in soil brought to the surface by gophers. A sample was taken from the center of the mound using a stainless steel scoop. This set was designated as "Old Mound Soil." Because of funding restrictions, this set of samples was not analyzed for radionuclide concentrations, therefore, will not be discussed further in this report.

A second set was comprised of three scoops taken 0.91 m (3 ft) from the center of the mound at 120-degree angles from each other. These were composited for each

mound. The composite was placed in a plastic resealable bag and shaken to obtain uniformity. This sample set was designated "Off-Mound Soil."

The third and final set of samples was taken after the mound-clearing event. This was to evaluate fresh mounds that were formed within a 48-h period. These samples were labeled "Mound Soil." Mound Soil samples were chosen for analysis because (1) they consisted of soil brought to the surface by gophers relatively recently, thus minimizing the amount of time during which wind or precipitation could influence the radionuclide concentration in the mound soil and (2) this made the age of the mound soil generally consistent from one site to another. Each sample was placed in a 500-mL plastic sampling jar, labeled with chain-of-custody tape, and frozen until they were submitted for analysis. The scoops were cleaned with mild soap and water between each collection.

All samples from Sets 2 and 3 were submitted to the Chemical Science and Technology (CST) Division at LANL for ^{3}H, ^{238}Pu, ^{239}Pu, ^{241}Am and total U analysis.

Only for purposes of site characterization, a composite soil sample from each site was collected for analysis of general chemical (pH, etc.) and physical properties (e.g., texture and bulk density). The composite consisted of five sub-samples: one taken from each corner and one from the center of each site. These were submitted to Paragon Analytics in Fort Collins, CO.

4.6 Vegetation Sampling

4.6.1 Radioisotope Analysis

Three samples of vegetation were collected from each site at Area G and one sample from each control site. Vegetation samples were collected using clean steel sheers. The vegetation was brushed lightly with the sheers before collection to remove excess soil. Vegetation was collected outwardly from the center of the mound until enough sample was collected for analysis, approximately one-half of a 3.8-L plastic bag. The maximum distance from the mound was recorded. These distances are presented in Table A-2. The samples were processed in the Soil and Foodstuffs laboratory at the Ecology Group using the procedure in "Produce Sampling and Processing for the Foodstuffs Monitoring Program" (LANL-ESH-20-HCP/OP-SF-001, R0; Fresquez, 1999b).

A distillation setup was used to process samples for ^{3}H analysis. The distillation setup consisted of placing a 100-mL beaker upside down in the center of a 1-L sample beaker, with a 50-mL beaker placed upright on top of the 100-mL beaker. Vegetation is placed at the bottom of the 1-L beaker to approximately reach the top of the 100-mL beaker. A watch glass is placed on top of the beaker and then sealed with plastic wrap. A beaker filled with ice is placed on top of the watch glass to aid in condensation. The apparatus is warmed slowly on a hot plate until condensation begins to form on the watch glass. The condensation then drips into the 50-mL beaker and is collected when 15 to 20 mL has accumulated. The distillate is then placed in labeled 20-mL polyethylene sample bottles and refrigerated until analysis is conducted. The dehydrated vegetation is then placed with the rest of the vegetation, covered with aluminum foil, vented, and placed in the ashing ovens. The samples were burned for five days, raising the temperature step-wise from 75°C to 500°C. After ashing, the vegetation is transferred to a 500-mL polyethylene sample bottle, labeled with chain-of-custody tape, and submitted to CST at LANL for ^{3}H, $^{238,239}Pu$, ^{241}Am, total U analysis.

4.6.2 Vegetation Site Characterization

For purposes of characterizing the site, plant frequency, density, and cover were analyzed using a modified community structure analysis (CSA) method described by Pase (1980). Transect size varied with the size of the site. Three 10-m transect plots were used on Study Sites 1A, 1B, 3A, and 3B. Three 30-m plots were measured on Study Site 2. The direction of transects was chosen randomly. A measuring tape was tied between two re-bar driven into soil at either end of the transect. Cover was estimated by rating the percentage of each of five 10-cm microplots at every meter along the transect. Only basal cover was estimated, so 100% of the ground cover was accounted. Circular quadrats of 0.5- by 1-m were used to conduct density counts. Density counts were taken every 5 m on the larger transects (for a total of five) and every 2 m on the smaller transects (for a total of four). Only plants rooted within the quadrat were counted. Frequency was determined by counting presence or absence of a species in the density quadrats.

4.7 Pocket Gopher Sampling

Four gophers were trapped at each Area G site, and two at each control site. Live trapping using Sherman® live traps failed to capture any gophers. Therefore, we switched to Victor® pinch traps. Pinch traps have a spring mechanism in which two claws pierce the animals' lung or abdomen area. If an animal was still alive when the traps were checked, Halothane® was used for euthanization. The pelt was separated from each gopher carcass, and each pelt and carcass was placed separately in 1-L beakers. Pelt and carcass weights were recorded independently (Table A-3). ^{3}H processing and ashing procedures were identical to those for vegetation processing. The ashed pelts were combined for each Area G site to obtain at least the minimum weight (2 g) necessary for analysis. Two control site samples were obtained by combining one pelt from each site. Wet, dry, and ash weights were measured and recorded. Ash:dry, dry:wet, and ash:wet ratios were calculated (Table A-3). The distillate and ashed samples were then placed in labeled 500-mL sample bottles and sent to CST at LANL for analysis of ^{3}H, ^{238}Pu, ^{239}Pu, ^{241}Am, and total U.

4.8 Chemical Analysis

All samples were sent to the LANL CST laboratory for chemical analysis. ^{241}Am was analyzed using a radiochemistry and alpha spectrometry procedure (Goldstein et al., 1995). Ion exchange and alpha spectrometry were used to analyze Pu (Peters et al., 1995), kinetic phosphorescence analysis was used for total U (Gonzales and Slemmons, 1993), and a distillation and liquid scintillation counting method was used for all ^{3}H samples (Peters et al., 1993).

4.9 Statistical Analysis

One-way analysis of variance (ANOVA) tests were used to detect differences in treatment means for the purpose of inferring treatment effects. The following method for statistical analysis of data sets containing negative values is similar to that described by Ibrahim et al. (1999). A constant value was added to data sets containing negative values to obtain positive values before transformation. Negative values were not excluded or set to zero, since this would bias the mean estimates upward (Ibrahim et al., 1999). Negative values may occur when either the analytical baseline value for a particular set of samples falls below the "true" baseline value or if the sample concentration is actually below the analytical baseline

concentration. Theoretically, the baseline value should be approximately zero, an average of positive and negative observations. A constant was chosen based on its ability to obtain all positive values and not change the relationship between media. This was done by comparisons of the plotted log transformed data excluding the negative values and with those where a small constant was added. It was found that adding a constant to the most negative point that results in an equivalent value of the smallest positive point does not change the relationship of the data significantly and therefore was the basis for our choice of constants. The data were then log transformed before analyzing with ANOVA. Least significant difference (LSD) tests were used to detect where the differences occurred (Steele et al., 1997). Gilbert's (1987) minimum variance unbiased (MVU) estimator was used to estimate the mean and variance on the log transformed data. The constant, if one was used, was subtracted after the MVU estimator was applied. Non-parametric Kruskal-Wallis tests (Gilbert, 1987) were used to examine differences in means whether a constant was used or not. The concentrations for carcass, pelt, and vegetation data are in pCi/g ash weight.

Correlations between media were tested statistically by examining correlation coefficients (r) and corresponding probability (p) values using an $\alpha = 0.05$ confidence level. Student t-tests assuming unequal variance were applied to determine if higher radionuclide concentrations existed in carcasses or mound soil compared with off-mound soil. The carcass data were first converted to a dry weight basis using the ash:dry ratios for each gopher (Table A-3) before log transformation. Student t-tests were applied only for sites containing higher radionuclide concentrations than the controls as detected in the LSD tests. Because these data did not contain negative values, a constant was not incorporated into any of the test values.

4.10 Assumptions

There were several assumptions made when collecting and analyzing the data during this study. We assumed that pocket gophers spent the majority of foraging and nesting time in the treatment site in which they were caught. This is fairly justified in that all the study sites were bound on all sides by either a road or a boundary fence and knowledge of the general home range (10 to 75 m^2) for this species. No mounds or tunnels were noted across any of the roads.

The data were assumed to be lognormal in distribution. With such a small sample size, it is difficult to assess normality. Most environmental radiological data are assumed to follow the lognormal distribution (USDOE, 1991). However, the negative values obtained in a few of the data sets do not follow the lognormal distribution. To correct for this, nonparametric tests were also used as a backup to parametric results on the data sets with negative values.

Pocket gophers were assumed to be of similar age and weight on average at each site. Older gophers would indicate an older, more developed burrow system with deeper and more extensive tunnels and feeding chambers. These gophers might therefore have a greater chance of burrowing into waste contained at the site. Differences in weight might result in variation in the amount of ingested contaminated vegetation or soil. A higher consumption rate of vegetation would result in a greater chance of consuming contaminated vegetation, as well as a greater intake of this vegetation. The variation in pelt and carcass weight is shown in Table A-3.

Lastly, the radionuclide concentration found in vegetation was assumed to be representative of the concentrations available to gophers as forage and representative of the concentration of the entire plant. Only plant top-growth was collected in this study. Previous experimentation at LANL indicated that radionuclides may concentrate in the rhizosphere soil (Gonzales et al., 1995), therefore, the intake of radionuclides from plant roots could be higher than from top-growth in cases where there is contamination in the rhizosphere. In general, however, actinide elements, which include Am, Pu, and total U, are poorly absorbed by plant tissue from soil (Whicker and Shultz, 1982). The soil-to-plant transfer coefficients are all much less than one as follows: Am–5.5×10^{-3}, Pu–4.5×10^{-4}, and U–8.5×10^{-3} (Baes, 1982). Since it is mobile with the aqueous phase, ^{3}H may be the only radionuclide measured that is truly represented in plant tissue resulting from plant uptake. Most radionuclides associated with plant material are adhered to the surface of plants.

4.11 Uncertainty

In addition to assumptions in the collection of data, there are underlying uncertainties associated with the data itself. There are four sources of uncertainty: the variability in the population, sampling error, estimation error, and measurement error. There is a natural variability associated with the radionuclide concentrations of the whole population. There are several potential sources of error during the sampling phase of our study. The greatest limitation in our study design is the sample size. Because of the small sample size, which was associated with the high cost of analytical analysis, there is uncertainty associated with the statistical analyses including the ANOVA, LSD, and Student t-tests. As will be discussed later, environmental conditions that could not be controlled during the sampling period can influence the short-term concentration of tritium, which in turn alters the exposure to environmental media. The samples represent an estimate of radionuclide concentrations in media at our study sites over the duration of our collection period and do not necessarily represent the radionuclide concentrations over a larger temporal or spatial scale. Error results from estimating the mean and standard deviation in all statistical tests including the ANOVA, LSD, Student t-test, correlation, and MVU. The measurement, or analytical uncertainty, represents the standard deviation that would occur if a sample were analyzed repeatedly (Mullen et al., 1998). This uncertainty is caused by radiological decay of the samples, sample preparation, and instrument limitations (such as drift) in the analysis. An analytical uncertainty value was presented with each measured concentration value. We did not quantify the effects of all of the potential sources of uncertainty on the data.

5.0 Results and Discussion

5.1 Population Estimate

The equation used for estimating gopher population density from fresh sign in the 48-h count test (Reid et al., 1966) was:

$$Y = 0.6582 * \text{sqrt. } X * \log (X+1), \quad (1)$$

where Y = # gophers/acre and X = # fresh sign (mounds) 48 h after clearing all existing mounds. Although our study sites were not an acre in size, which is the size on which the method is based, we applied the equation to our study site counts. Even by rounding upward to the nearest whole number, our estimates of population size using the equation were smaller than the number of gophers actually trapped. The estimates include Study Sites 1A – 2 gophers/0.2 ac

(10/ac), 1B – 1 gopher/0.04 ac (24/ac), 2–7 gophers/ac, 3A – 3 gophers/0.23 ac (13/ac), and 3B – 2 gophers/0.04 ac (50/ac). At least four gophers were captured at each site, proving the estimates are lower than the real population size.

There are several possible explanations for the small estimate of population size. Plot area has been cited as an important component of the 48-h count. Engeman et al. (1993) observed that 0.02-ac (0.008-ha) plots did not provide an accurate measurement of activity. Reid et al. (1966) noted that the amount of plots necessary to accurately predict population increased when the population was low. Although there were at least four gophers caught per plot, the long duration necessary to catch all samples indicates a fairly low population size. Also, the 48-h mound counts in this study were conducted in mid-July, whereas the Reid et al. (1966) study that established the regression equations used was conducted in August through September.

5.2 Soil Characteristics

Results of the analysis of soils for physical and chemical characteristics are shown in Table A-4. All treatment sites were similar in texture, pH, and organic matter. There is however a fairly large discrepancy in the cation exchange capacity (CEC), with a range of 3.2–12.3 meq/100g. The control sites generally had a substantially higher clay content, CEC, and organic matter content than the treatment sites. The lowest bulk density was noted in Control Sites 1 and 3. This is most likely caused by the higher organic content of the soils, which tends to decrease bulk density (Pierzynski et al., 1994). The higher clay content and organic content of the control sites might also suggest that there is a higher binding capacity for radionuclides at these sites than at Area G.

5.3 Vegetation Characteristics

As previously discussed, under certain conditions, vegetation can influence the dynamics of contaminant movement and distribution. Vegetation can reduce surface runoff of precipitation and increase infiltration into soil covering buried waste. The presence of gophers can magnify these processes by channeling water to greater depths within a soil profile in a non-uniform manner, but for any radionuclides that are deposited on the soil surface, plant roots tend to retain radionuclide particles in the rhizosphere region of soil. The retention of radionuclides in the root zone most likely results from retentive forces associated with plant roots.

Area G is dominated by vegetation that is typical for disturbed piñon-juniper woodland. Predominant plants include blue grama grass (*Bouteloua gracilis*), cryptogamic soil crust, and prickly pear cactus *(Opuntia* spp.). Other common vegetation at Area G includes broom snakeweed (*Gutierrezia sarothrae*), pinque (*Hymenoxys richardsonii)*, muttongrass (*Poa fendleriana)*, false tarragon (*Artemisia dracunculus)*, leafy golden aster (*Chrysopsis filio*sa), and three-awn grass (*Aristida* spp.) (Usner, 1995).

Using the CSA method (Pase, 1980), estimates were made of plant cover and density on the study plots. Species importance was also estimated using the CSA method. Basal cover was found to be a poor estimator of dominance because of the relative small size of species present, so only density and frequency estimates were used. Site 1A was dominated by false buffalograss (*Monroa squarrosa)*, fetid marigold (*Dyssodia papposa)*, ragleaf bahia (*Bahia dissecta)*, sand dropseed (*Sporobolus cryptandrus)*, Fendler three-awn (*Aristida purpurea* var. *longiseta)*, and flatspine burr ragweed (*Ambrosia acanthicarpa)*; Site 1B:

Fetid marigold, common purslane (*Portulaca oleracea)*, sand dropseed, kochia (*Kochia scoparia)*, and wooly plantain (*Plantago patagonica)*; Site 2: blue grama, western wheatgrass (*Pascopyrum smithii)*, firewheel (*Gaillardia pulchella)*, sideoats grama (*Bouteloua curtipendula)*, and hairy goldenaster (*Heterotheca villosa)*; Site 3A: cheatgrass (*Bromus tectorum)*, firewheel, sand dropseed, spurge (*Euphorbia* spp.), and ragleaf bahia; Site 3B: false buffalograss, ragleaf bahia, flatspine burr ragweed, spurge, and Bigelow's tansyaster (*Machaeranthera bigelovii)*. All sites were observed to be heavily disturbed areas with the exception of Site 2, which appeared to have more long-standing, mature vegetation.

The estimate of pocket gopher population density, the characterization of soil physiochemical properties, and vegetation characterization were conducted to assist in describing the physical nature of our specific study sites within Area G. Although these descriptive measures do not directly affect the results of this study, this information may be useful in future modeling efforts.

5.4 Paired T-tests and Upward Transport of Radionuclides by Gophers

The primary objective of the study was to infer whether gopher activity was responsible for moving radionuclide-contaminated soil to the surface, which would implicate whether intrusion of gophers into waste cells may be occurring. To answer this question, one-way Student t-tests assuming unequal variance were conducted to determine if significantly greater radionuclide concentrations existed in mound soil compared to the off-mound soil (H1) and carcass compared to off-mound soil (H2). The tests were conducted using the estimated mean from the MVU estimator. Student t-tests were conducted only for sites containing higher radionuclide concentrations than the control sites as measured by the LSD tests discussed in Sections 5.6 through 5.8. Both comparisons would aid in determining if pocket gopher activity is bringing contaminated soil to the surface. The off-mound soil served as a localized reference comparison value, and the carcass and mound soil served to implicate the intrusion of gophers into waste and/or soil. Each carcass concentration was converted to units per dry weight using individual ash:dry weight ratios (Table A-3).

A higher radionuclide concentration in the mound soil compared to off-mound soil could be indicative of pocket gopher intrusion into contaminated soil or waste and subsequent transport to the surface. This method for implicating whether animal intrusion has occurred is similar to the techniques used in the studies conducted by Arthur and Markham (1983) and Shuman and Whicker (1986), though it was conceived at LANL before reviewing these publications. In both studies, higher radionuclide concentrations were detected in the excavated soil compared to the surrounding soil. In both studies it was concluded that intrusion into buried contaminated soil had occurred. Arthur and Markham (1983) concluded that the 1.2-m soil cover over the waste cell did not prevent upward transport of contaminated soil by small mammals. The mounds sampled in our study were created within a 48-h period before sampling, which, combined with the facts that there was no precipitation and winds were light, enabled the assumption that dispersal of radionuclides from the mound through erosion did not occur.

The analytical reports with "raw" radionuclide data are attached in Appendix B. The results of the mound vs. off-mound t-tests on radionuclide data are presented in Table A-5. All tests indicate there was no

significant difference in radionuclide concentration between mound soil and off-mound soil. The tests failed to reject the hypothesis (H1) of equal radionuclide concentrations between mound and off-mound data. From these results it can be inferred that gophers generally are not directly transporting contaminated soil to the soil surface.

Had it occurred, a higher radionuclide concentration in the gopher carcass compared to the off-mound data would have also indicated intrusion into contaminated soil or waste, however, this generally did not occur. Smallwood (1996) found significantly higher radionuclide concentrations in a gopher carcass compared to the surrounding surface soil, concluding that intrusion into a waste cell had occurred. The results for the carcass vs. off-mound t-tests on radionuclide data are presented in Table A-6. The t-tests failed to reject the null hypothesis (H2) of equal radionuclide concentrations between carcass and off-mound soil concentrations at any site for the Am data. Off-mound soil ^{238}Pu concentrations were significantly higher than carcass concentrations at Sites 1A, 1B, and 2. Significantly higher ^{239}Pu concentrations were detected in off-mound soil at Site 1B. ^{239}Pu concentrations were higher in the carcass at Site 3A. This might indicate that, at Site 3A, elevated ^{239}Pu concentrations exist at the subsurface depths that gophers occupy. However, the carcass concentration at Site 3A is not the highest overall mean carcass ^{239}Pu concentration. As shown in Section 5.8, these concentrations pose an inconsequential level of risk to the ecological receptors, using the pocket gopher as an indicator species. Also, because mound soil concentrations are not significantly higher than off-mound soil at Site 3A, the difference detected in carcass vs. off-mound soil may be the result of low sample sizes.

The ^{3}H data also indicated a significantly higher concentration in the carcass compared to off-mound soil at Site 3B. As noted above, ^{3}H is very water soluble and mobile in the environment. Many of the gopher mounds were noted to be directly adjacent to the shaft covers. Concrete waste covers over disturbed waste sites have been cited as ideal protection for den and feeding chambers of burrowing animals (Smallwood et al., 1998), and the burrows often reach greater depths than sites over undisturbed areas (Landeen and Mitchell, 1981; Reynolds and Laundre, 1988). Therefore, gophers residing below the shaft covers could have greater exposure to ^{3}H emanating from the shafts than gophers residing farther away from the shafts. As will be shown in Section 5.10, the ^{3}H at Study Site 3B is the only one to result in a dose to pocket gophers that is above a conservative ecological screening level. With the two exceptions noted above, the t-tests do not display higher radionuclide concentrations in either mound or carcass data when compared with localized contaminant concentrations in surface soils. It appears that, in general, gopher activity is not responsible for transporting contaminated soil to the soil surface at the locations sampled at Area G.

5.5 Potential Risk

To estimate potential ecological risk (H3), a dose to pocket gophers was calculated for each radionuclide. The calculation was based on the screening level ecological risk assessment methods used at LANL (LANL, 1999). A calculated dose higher than the conservative ecological screening level (or “safe limit”) of 0.1 rad/d (IAEA, 1992) is considered potential risk warranting further consideration. The equation used for calculating dose is

$$Dose_j = C_{org} * DCF_{int,j} + C_{soil,j} * DCF_{ext,j}, \quad (2)$$

where $Dose_j$ is the total dose from radionuclide j (rad/day), C_{org} is the internal concentration of radionuclide j (pCi/g organism) that was estimated from the MVU, $DCF_{int,j}$ is the internal dose conversion factor for radionuclide j (rad/day per pCi/g), $C_{soil,j}$ is the concentration of radionuclide j in soil (pCi/g), and $DCF_{ext,j}$ is the external dose conversion factor for radionuclide j (rad/day per pCi/g) (LANL, 1999). The internal and external dose conversion factors were obtained from the LANL Ecorisk Database (LANL, 1998). Since DCFs are not available specifically for the pocket gopher, the choice of the ecological screening receptor on which to base these values was based on similarities to the pocket gopher. Of the eight ecological screening receptors for which DCFs have been developed at LANL, the invertebrates, the deer mouse, and the shrew (*Sorex* spp.) were the most similar in size and/or foraging habits. DCF calculations were identical for invertebrate, shrew, and deer mouse screening receptors, therefore, no decision was necessary on using a DCF particular to one of these three species. All three species were assumed to spend at least a portion of the time underground. The calculation for the external DCF was based on immersion in contaminated water to account for a 360-degree exposure, so we applied a density correction factor (62.5%) to correct for the differences in density between water and soil. In the dose estimate equation, C_{org} radionuclide concentration is in units of fresh weight. Because the measured gopher concentrations are in units of ashed weight, the carcass radionuclide concentration was converted to fresh weight by the mean carcass ash:wet conversion factor (Table A-3) of 0.057 g ash weight/g wet weight. The total U dose was based on ^{238}U dose conversion factors. ^{238}U typically represents over 99% of the total U in rodent samples and therefore is usually the overwhelming contributor to total dose (Whicker and Schultz, 1982).

The lung and gastrointestinal tract were not separated from the carcass in this study. These organs are typically considered contributors to external dose for the period of time in which radionuclides reside in these organs before being excreted. These organs are not typically considered contributors to internal dose because little absorption across these organs occurs for Am, Pu, and total U (Whicker and Schultz, 1982). By including the contribution from lungs and the gastrointestinal tract in the internal dose calculation, we overestimated the dose to gophers from this source for Am, Pu, and U. The estimate for ^{3}H however should be fairly accurate because it exists in a physical state, water, that is easily extracted.

All estimated dose calculations (Table A-7) fall well below the ecological screening level of 0.1 rad/day except for ^{3}H at Study Site 3B, which had an estimated dose of 9.1 rad/day. This is the only dose high enough to result in potential harm to the individual pocket gopher (Eisler, 1994). As mentioned earlier, the high estimated dose of ^{3}H in gophers at the treatment sites might be associated with time of collection, as ^{3}H is more mobile during times of higher precipitation and variable barometric pressure. However, this might be an indication that more engineering controls are necessary to prevent ^{3}H from further movement from its containment cell. Because ^{3}H is water soluble it more easily crosses membranes in the gopher than other radionuclides, more readily absorbs across plant root tissues, and is mobile in soil because of its solubility in soil pore water. As discussed above, the relatively high concentrations in all media at the treatment

sites could be attributed to environmental conditions at the time of collection such as higher than normal precipitation or barometric pressure fluctuations.

5.6 Comparisons with Past Surveillance Data

Radionuclide concentrations in soil and vegetation at Area G have been monitored for many years as part of the Laboratory's Environmental Surveillance Program. The 1998 data from LANL (1999) were compared to the results of this study. Comparison sites were chosen based on proximity to study sites. The Surveillance Site 7b is located approximately 30 m downslope to the southeast of the TRU waste shafts and was used in comparison to Study Sites 1A and 1B. Surveillance Site 7a is located directly above Disposal Pits 17 and 18, which directly corresponds to the area of Study Site 2. Study Sites 3A and 3B were compared to Surveillance Sites 1 and 2, respectively, which are situated just outside the boundary fence less than 30 m to the south and west of the study sites.

The complete 1998 surveillance results are presented in Table A-8. Pu and Am concentrations are generally between two and three orders of magnitude higher in the study sites than in the surveillance sites. The ^{3}H data were considerably higher in all the study site data, ranging upward to five orders of magnitude greater than the surveillance results. There was very little difference between study site and surveillance site data for total U. The greatest differences in radionuclide concentrations occur for the study sites in which higher than background concentrations were detected in the LSD tests. A radionuclide concentration gradient appears to exist, with the greatest concentrations occurring in areas surrounding the PRSs that were located within our study sites.

5.7 Americium

The results for the ^{241}Am analysis are presented in Figures 4 through 6 and Table A-9. A constant was added to the carcass (0.0054) and vegetation (0.0065) data before comparison tests were conducted to obtain positive values for the log transformation. One-way ANOVA tests showed that at least one significant difference ($\alpha = 0.05$) in the mean concentration of ^{241}Am existed between study sites for mound soil, off-mound soil, and vegetation data ($p<0.001$). Kruskal-Wallis tests also rejected the null hypothesis of equal ^{241}Am concentrations between study sites in all media except for carcass data. The LSD tests were used to determine where significant ($\alpha = 0.05$) differences exist.

The results lead us to reject the null hypotheses (H1, H2, and H3) of equal ^{241}Am concentrations between sites for mound soil, off-mound soil, and vegetation data. We failed to reject the null hypothesis of equal Am concentrations for the carcass data. The mean pelt concentration for the treatment sites (0.119 pCi/g) is an order of magnitude higher than the control mean concentration (0.013 pCi/g). The highest concentrations of Am for all data sets occurred in Study Sites 1A, 1B, and 2. These sites had significantly higher ^{241}Am concentrations than the control group in mound soil and off-mound soil. Sites 1A and 1B had significantly higher ^{241}Am in the vegetation as well.

Carcasses did not have higher than background concentrations of Am at any study site within Area G. As will be shown in Section 5.8, carcasses did generally have elevated levels of Pu. Am is generally more mobile in soil and more readily absorbed

Figure 4. Concentrations of ^{241}Am in mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

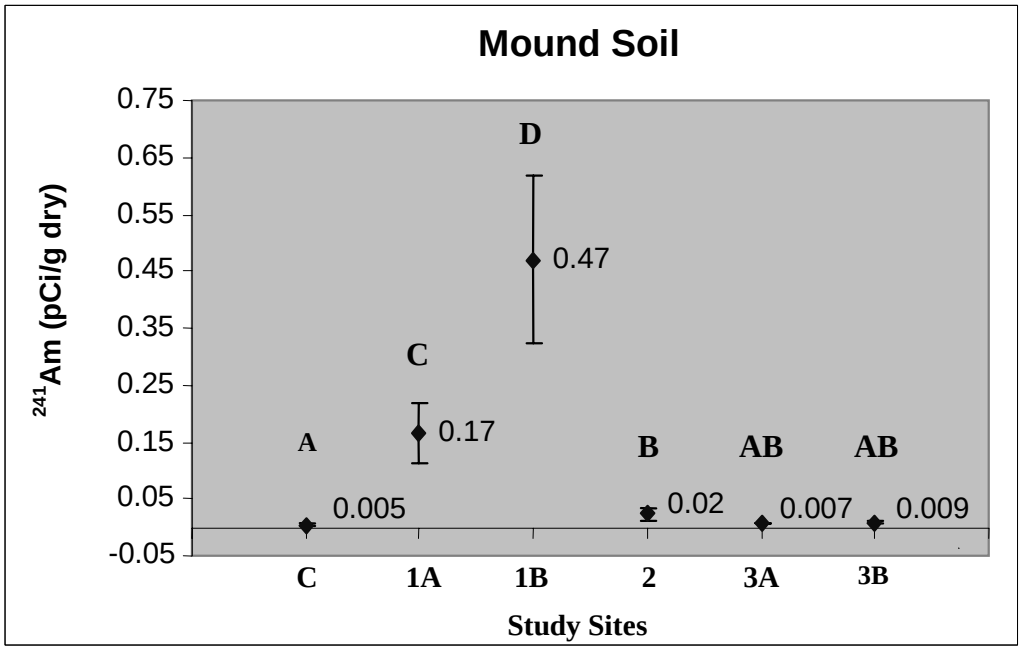


Figure 5. Concentrations of ^{241}Am in off-mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

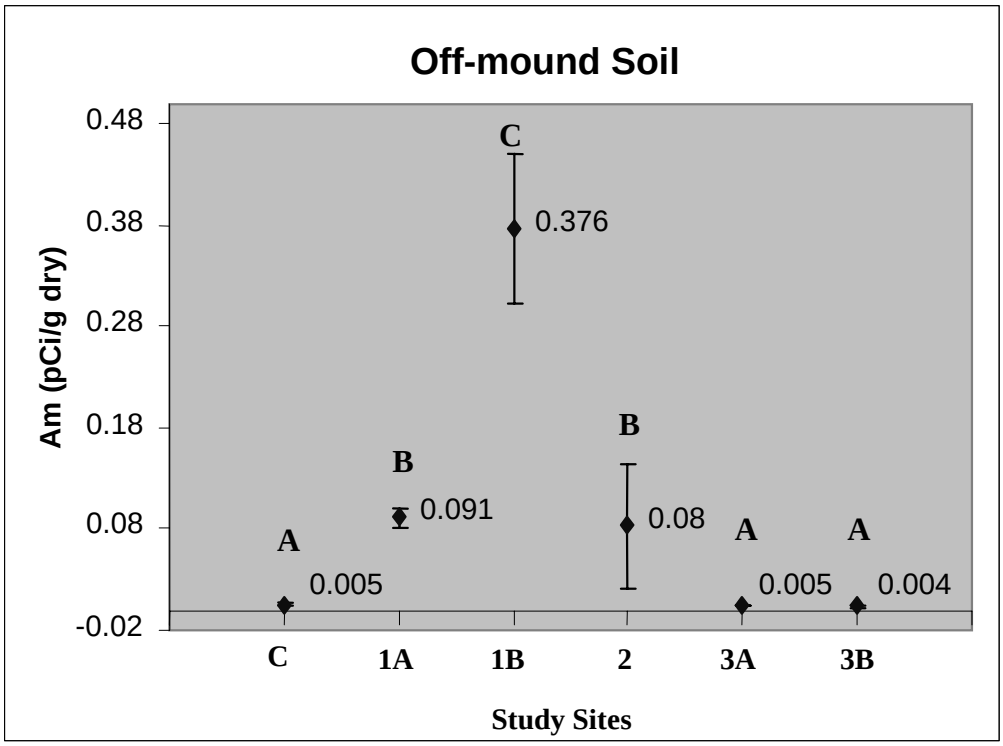
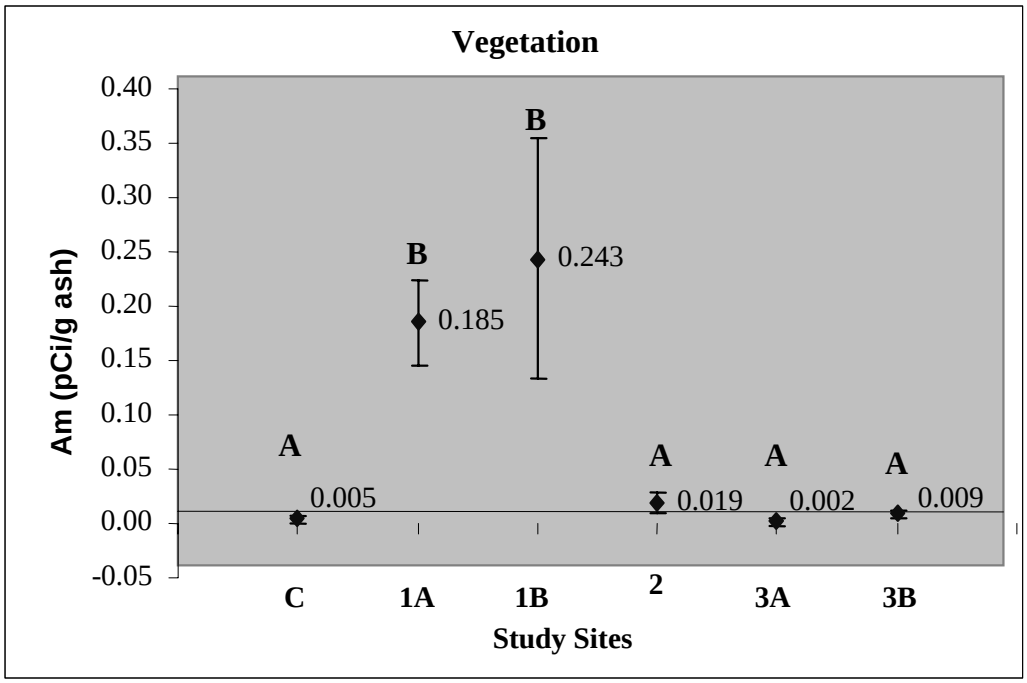


Figure 6. Concentrations of ^{241}Am in vegetation. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.



through the gastrointestinal tract than Pu (Coughtrey et al., 1984). This may in part explain the difference in ^{241}Am compared to Pu, however, there were also analytical problems with ^{241}Am. As a quality assurance measure, CST attempts to maintain a minimum of 30% recovery of "marker" analytes "spiked" into some samples, in this case ^{243}Am. Forty-three percent of our Am carcass samples had less than 30% recovery, some of which only reached 6% recovery. Unknown constituents within the samples interfered with the column chemistry, allowing excess material to pass with the analyte of concern, providing lower than normal tracer recovery values (Brooks, personal communication). For comparison purposes, Am concentration:uncertainty ratios were calculated on the raw data for the carcass and mound soil for Am, ^{238}Pu, and ^{239}Pu. The carcass data had the lowest ratio, indicating that this data had the greatest analytical uncertainty. This analytical uncertainty may have interfered with the analyses of ^{241}Am.

The elevated levels of Am at Study Sites 1A and 1B are not likely the result of gopher intrusion into the TRU waste shafts. These are the same sites in which contaminated topsoil containing detectable levels of Am and Pu was placed. The topsoil is a more likely source of the elevated levels of Am in the environmental media because of the ubiquitous nature and similar concentrations of Am detected.

5.8 Plutonium-238/239

A constant was applied to the ^{238}Pu (0.0015) and ^{239}Pu (0.0062) vegetation data before transformation. ANOVA ($\alpha = 0.05$) tests found at least one significant difference in mean ^{238}Pu and ^{239}Pu concentrations for carcass, mound soil, off-mound soil, and vegetation data ($p<0.001$). The Kruskal-Wallis test also detected a difference in mean concentrations for these media. The

average pelt ^{238}Pu and ^{239}Pu concentration of the five treatment sites was compared with the two pelt samples from the control sites. Although no statistical tests were used on pelt data, the results are consistent with the other tests in which the treatment sites generally had higher radionuclide concentrations than the control. The pelt data indicate that there was a higher mean concentration for all treatment sites (0.163, 0.162 pCi/g) than control sites (0.0006, 0.008 pCi/g) for ^{238}Pu and ^{239}Pu, respectively. The results of the MVU and LSD (α = 0.05) for ^{238}Pu are given in Figures 7 through 10 and Table A-10. The results of the MVU and LSD (α = 0.05) for ^{239}Pu are given in Figures 11 through 14 and Table A-11.

The results of the ANOVA and LSD rejected the null hypotheses (H1, H2, and H3) of equal Pu concentrations between sites for carcass, mound soil, off-mound soil, and vegetation data. Although concentrations for the two isotopes of Pu differed in every media, the LSD tests display similar trends in Pu concentrations. For both isotopes, significantly higher than background (control) concentrations were found at Study Sites 1A, 1B, and 2 for all media, the only exception being the carcass data for ^{239}Pu, which had differences at Sites 1B, 2, and 3A.

It is interesting to note that the highest concentrations of both Pu and Am occurred at Site 1B, the area in which contaminated soil was accidentally used as topsoil. This could also explain the elevated concentrations in environmental media at Site 1A. Once again, this might be a more feasible explanation of higher concentrations of Pu and Am at these sites than disturbance of the TRU waste shafts. If intrusion into the waste cells had occurred, we would most likely have detected higher radionuclide concentrations in the carcass, pelt, and mound soil data than what was found. As can be seen in Tables A-10 and A-11, the ^{239}Pu concentration at Site 1B is higher than ^{238}Pu in all media. This is what we would expect looking at the nature of the contaminated topsoil that was spread in the area, which contained ^{239}Pu concentrations ranging from 29 to 39 times that of ^{238}Pu (Rogers, 1977; Conrad, 1997).

5.9 Uranium

The mean total U concentrations and standard deviation derived from the MVU for each media are presented in Table A-12. ANOVA (α = 0.05) and Kruskal-Wallis tests failed to reject the null hypotheses of no differences in total U concentrations between any study site. This held true for carcass, mound soil, off-mound soil, and vegetation data. Also, the non-transformed pelt concentrations were relatively close in total U concentration for the treatment (0.69 pCi/g ash) and control site (0.66 pCi/g ash). This is consistent with conclusions in other studies that natural deposits of U are the predominant source of U levels at LANL (Fresquez et al., 1999).

There was no detectable level of total U in the contaminated topsoil that was spread in the area of Site 1B. Since no elevated concentrations of total U were found at Sites 1A or 1B, this further strengthens the hypothesis that the elevated Am and Pu concentrations at these sites originated from a source other than the TRU waste disposal shafts, i.e., from the contaminated topsoil that was accidentally applied in 1976. If intrusion into waste cells had occurred at these sites, elevated levels of total U would most likely be detected in the environmental media as was the case in the example cited in Section 2.5 where a gopher excavated yellow cake and U-contaminated soil from the TRU shafts of Area G in early 2000.

Figure 7. Concentrations of ^{238}Pu in carcass. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

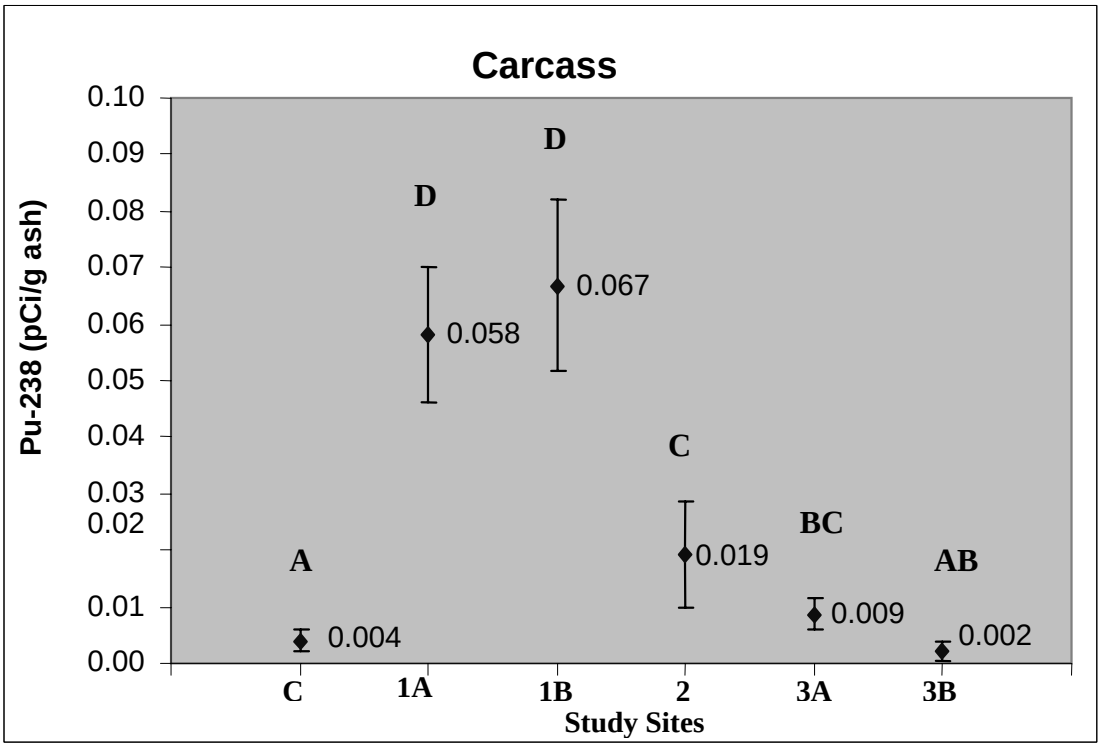


Figure 8. Concentrations of ^{238}Pu in vegetation. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

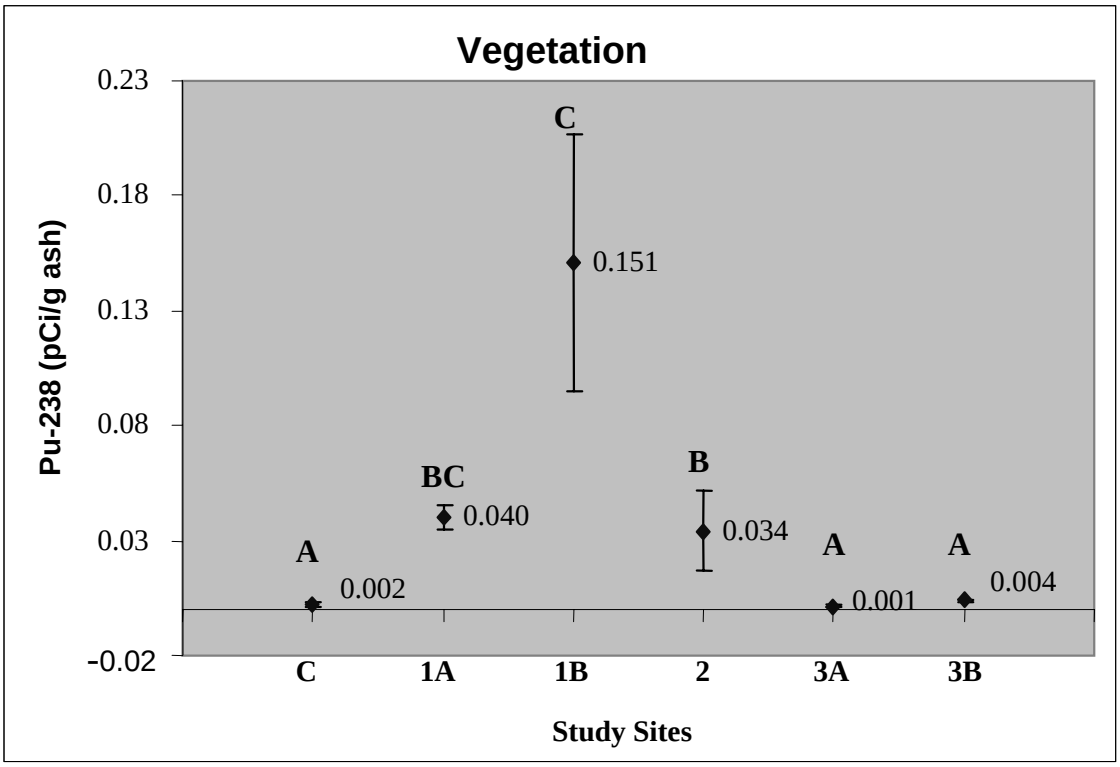


Figure 9. Concentrations of ^{238}Pu in mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

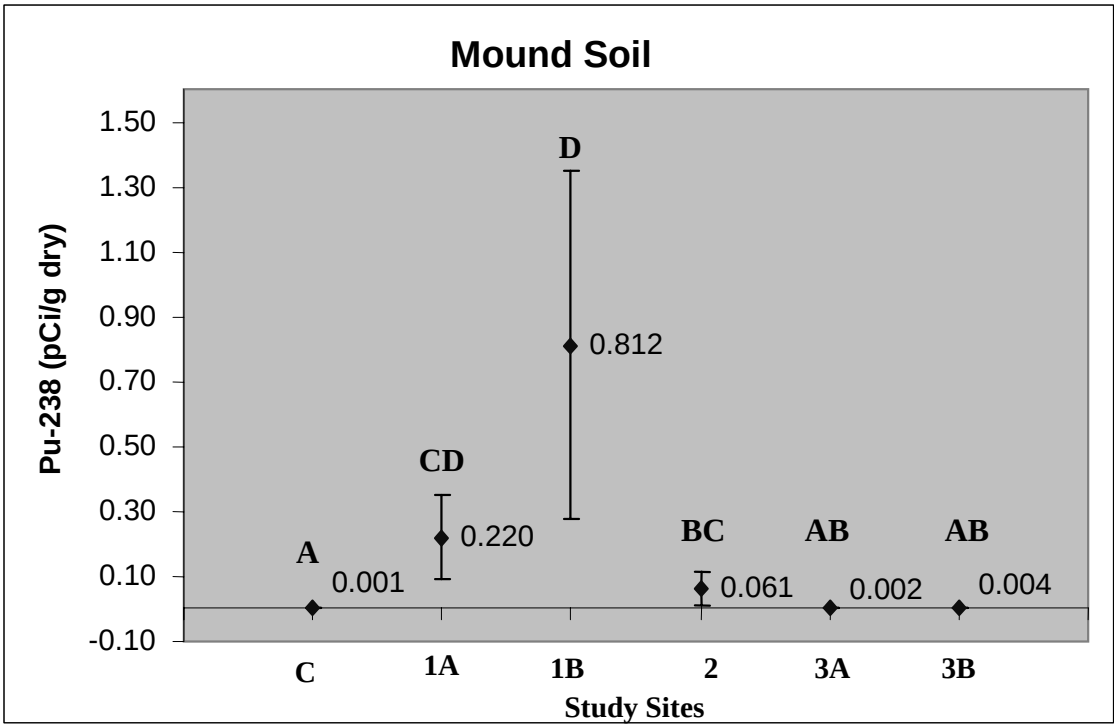


Figure 10. Concentrations of ^{238}Pu in off-mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

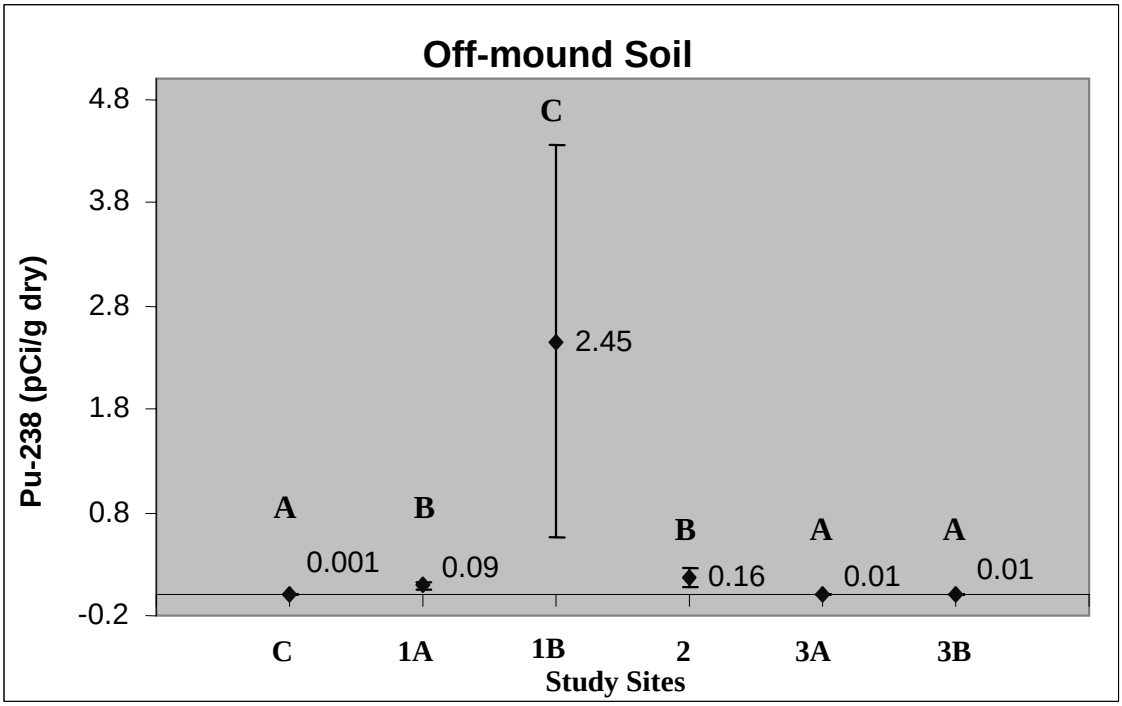


Figure 11. Concentrations of ^{239}Pu in carcass. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

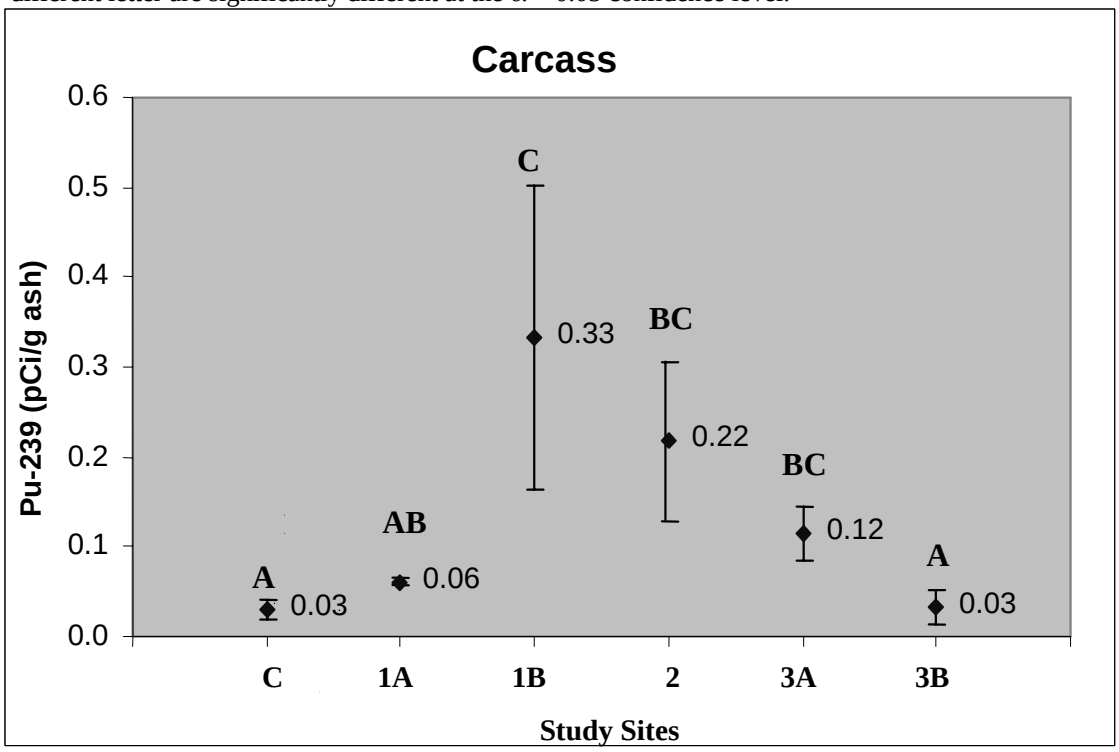


Figure 12. Concentrations of ^{239}Pu in vegetation. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

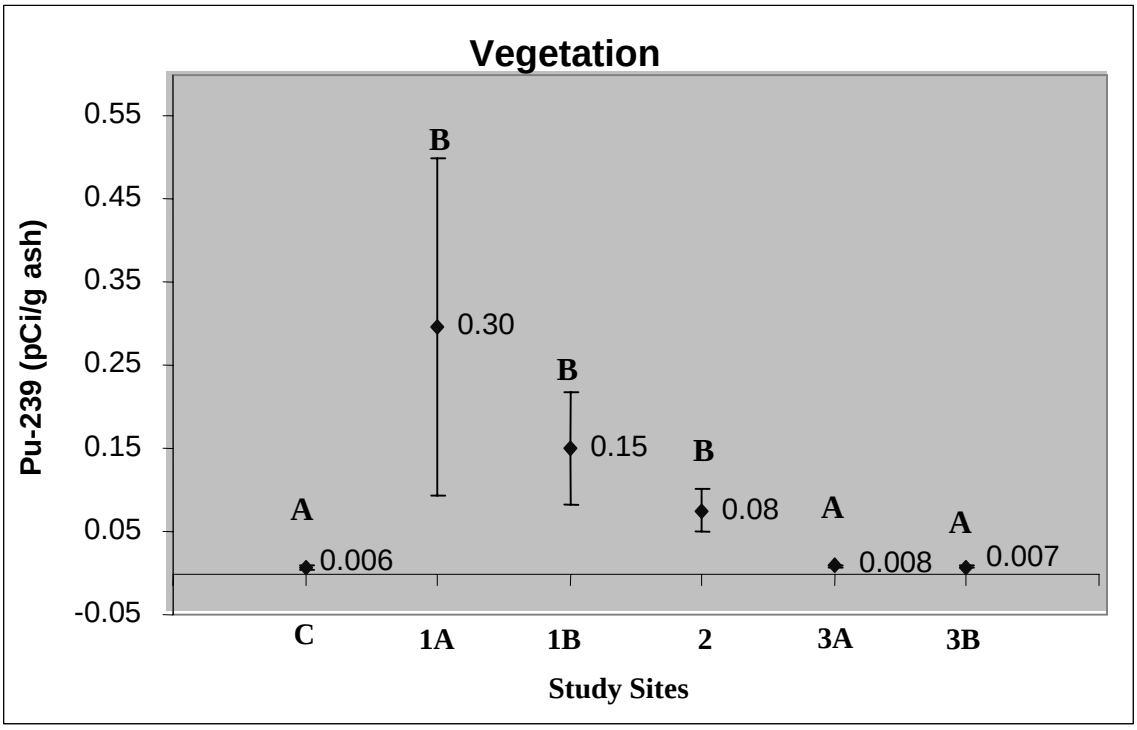


Figure 13. Concentrations of ^{239}Pu in mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

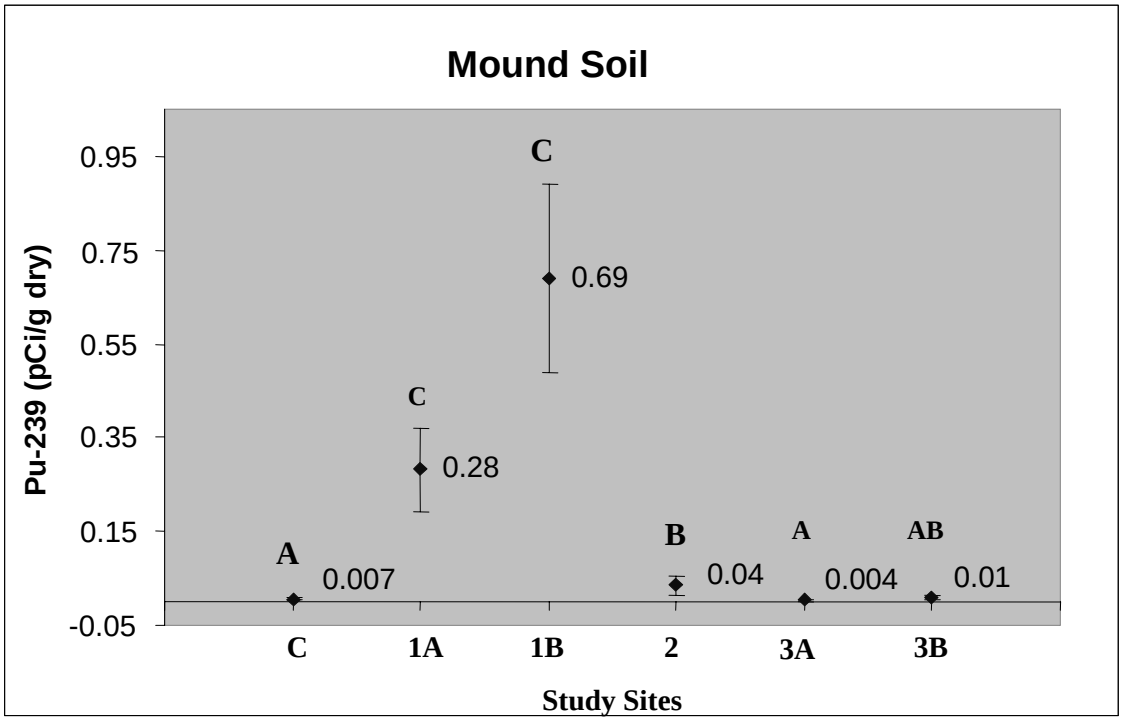
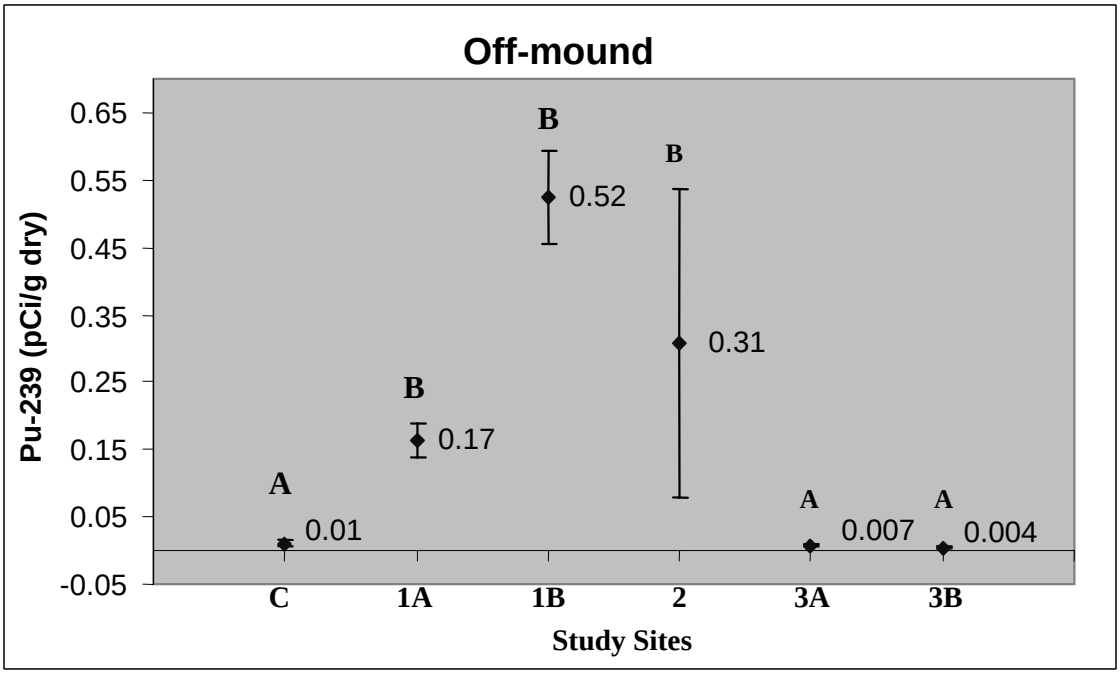


Figure 14. Concentrations of ^{239}Pu in off-mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.



5.10 Tritium

Constants were applied to the carcass (320), mound soil (860), and vegetation (510) data to acquire positive values. The results of the ANOVA ($\alpha = 0.05$) tests showed a significant difference between at least two means for carcass, mound soil, off-mound soil, and vegetation data ($p<0.01$). Kruskal-Wallis tests also detected a difference in mean ^3H concentrations for these media. Therefore, we rejected the null hypotheses (H3, H4, and H5) of equal ^3H concentrations between study sites for all environmental media sampled. Differences also appeared substantial for pelt data. The results of LSD tests ($\alpha = 0.05$) and MVU are provided in Figures 15 through 19 and Table A-13. Sites 3A, 3B, and 1A contained significantly higher ^3H concentrations than background for mound soil, off-mound soil, and vegetation data. Pelt data showed a difference at Site 1B as well as those mentioned for the other media. All treatment sites had significantly higher ^3H concentrations in carcasses than the control mean.

When ^3H emanates from the waste cell, it is converted to tritiated water during its diffusion through the subsurface (Vold, 1997). With the exception of a lower vapor pressure, tritiated water behaves almost identical to water in the environment (NCRP, 1979). This makes it very mobile in soil environments and allows quick absorption into the roots of vegetation. Typically, 100% is assimilated in the gastrointestinal tract when ingested (Higley and Kuperman, 1996).

The highest concentrations of ^3H were observed in Sites 3A and 3B, which are adjacent to the pre-1971 ^3H shafts. This is consistent with monitoring program results. In an intensive monitoring study of gas emissions from Area G, the only samples with above-background concentrations for ^3H were those surrounding the pre-1971 ^3H shafts, an area that accounted for over 90% of the total ^3H emissions from all of Area G (Radian Corporation, 1994).

In some cases the concentrations at the ^3H sites ranged upward of ten orders of magnitude greater than background levels. There are several potential reasons for the high concentrations of ^3H in the samples, especially those sites surrounding the pre-1971 ^3H shafts. Vold (1997) describes a concept known as barometric pumping, in which ^3H diffusion from the waste cells to the surface is accelerated by fluctuations in environmental barometric pressure. It has been estimated that this process creates an in-situ diffusion coefficient of approximately 1.5×10^{-3} m^2/s, which is 60 times the binary diffusion coefficient for water vapor when the pumping effect is not present (Vold, 1997). Also, precipitation levels around the time of sampling can influence the amount of ^3H diffusing to the surface. Large amounts of precipitation typically correspond to higher ^3H concentrations in surface media (Fresquez et al., 1999). The total precipitation for the months July through August, when the majority of samples were collected, was 22 cm compared with the normal 17 cm (The Weather Machine database, 1998). Variability in barometric pressure and above normal precipitation could have caused an increase in the diffusion of ^3H to the surface, increasing exposure of various environmental media including those measured in this study.

Am, Pu, and ^3H concentrations in Area G mound soil were sometimes higher than background. Age of the waste site has been indicated as an important factor for potential intrusion of burrowing animals into waste cells (Shuman and Whicker, 1986). Our study sites were all over 20 years old. Pocket gophers at older waste sites such as

Figure 15. Concentrations of ^{3}H in carcass. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

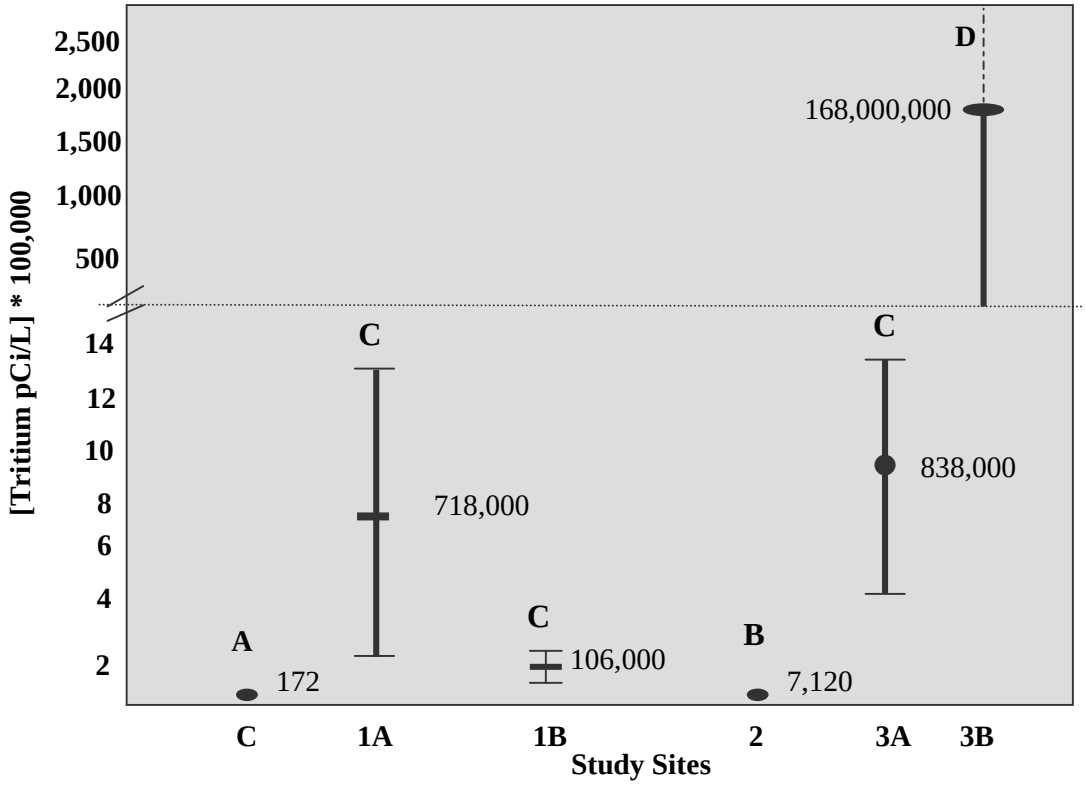


Figure 16. Concentrations of ^{3}H in pelts. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

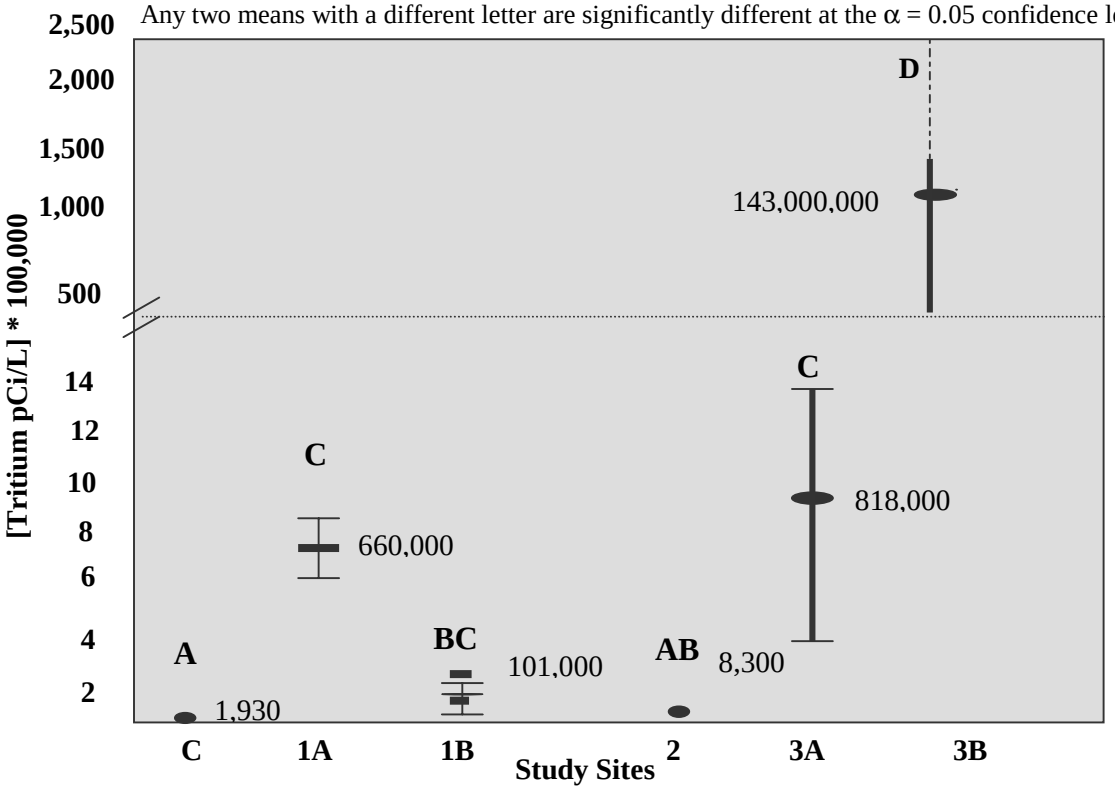


Figure 17. Concentrations of ^{3}H in mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

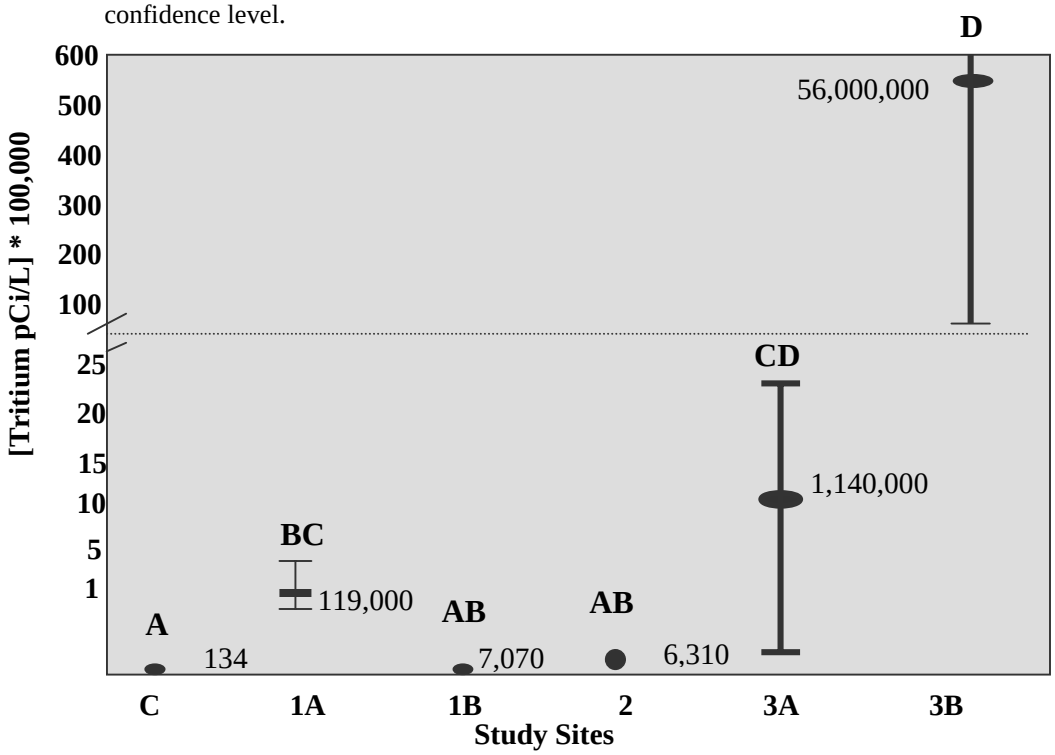


Figure 18. Concentrations of ^{3}H in off-mound soil. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.

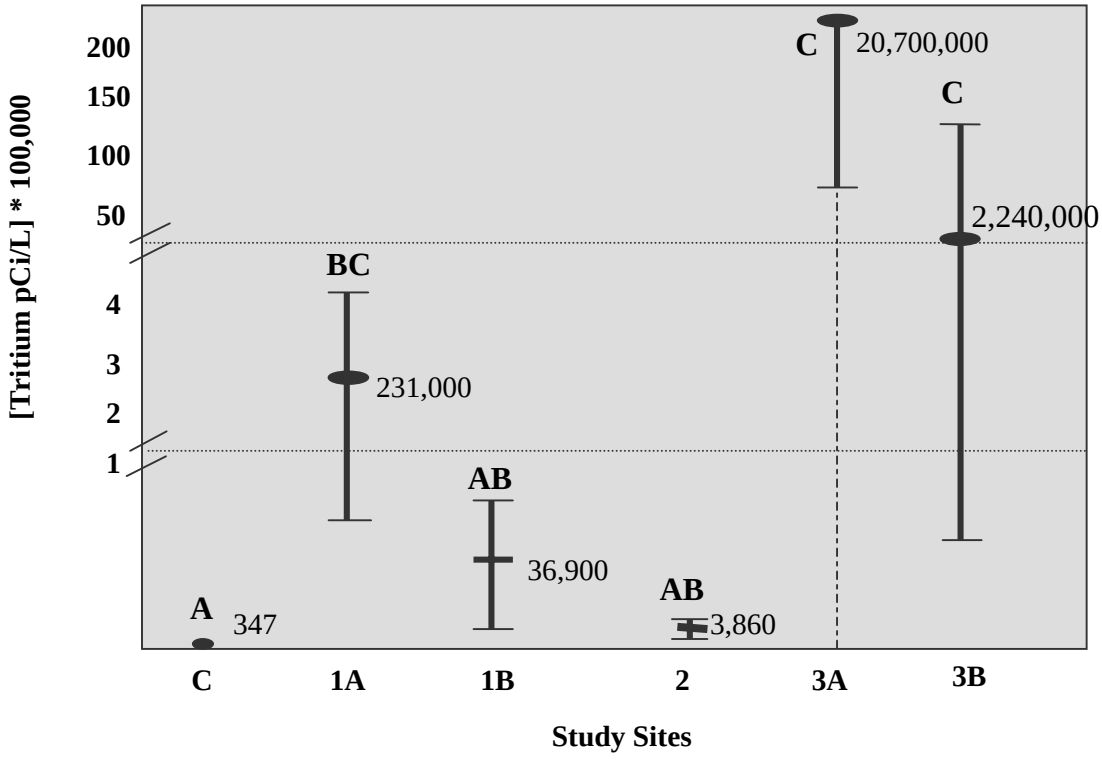
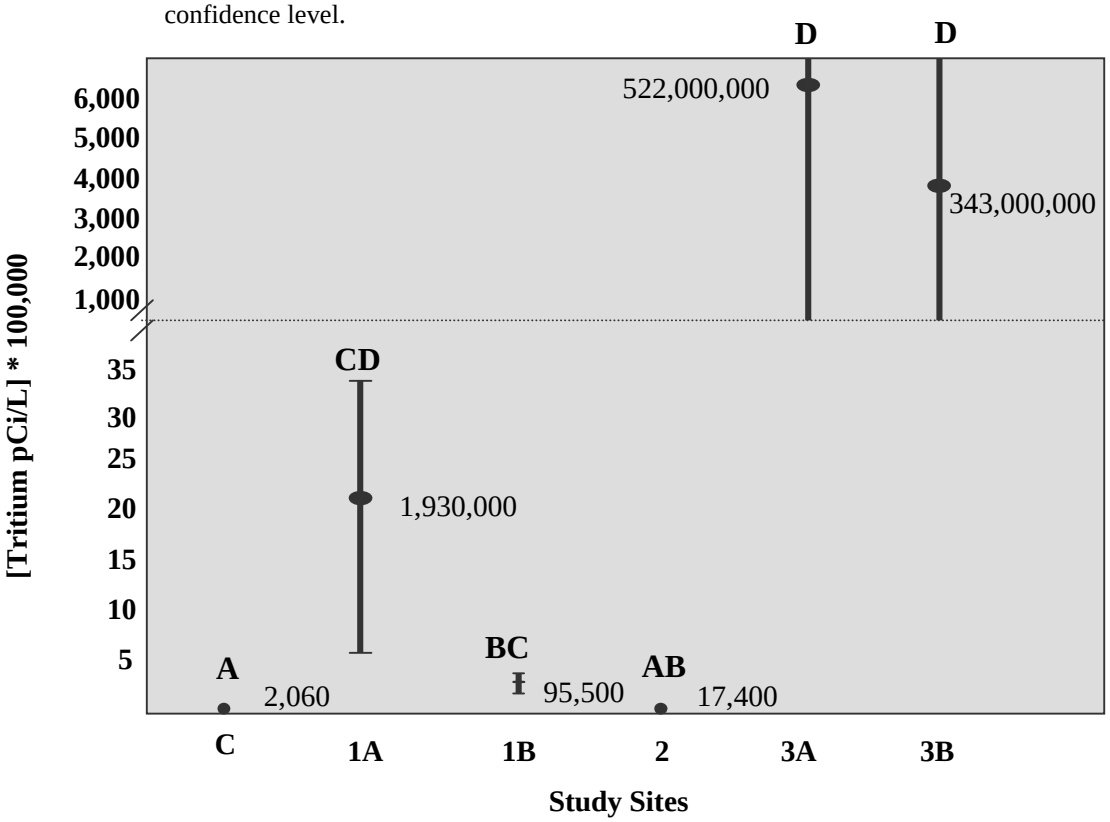


Figure 19. Concentrations of ^{3}H in vegetation. Values represent estimated mean using the MVU estimator. The letter on top of the standard deviation bar represents the results from the LSD test. Any two means with a different letter are significantly different at the $\alpha = 0.05$ confidence level.



ours would have had a relatively long period of time to distribute throughout the site and excavate a deeper and more extensive burrow system.

5.11 Media Relationships

Hypothesis 4 was concerned with possible radionuclide concentration relationships between soil, vegetation, and pocket gopher media. A strong correlation between media concentrations would be useful in predicting radionuclide concentrations in one media from another, more available, media. For example, concentrations of radionuclides in gophers could be predicted from concentrations of radionuclides in soil or vegetation. This would allow modeling of radionuclide transport through various trophic levels. Correlations, with corresponding probability (p) values, were obtained for all possible combinations of carcass, mound soil, off-mound soil, vegetation, and pelt data. Correlation coefficients (r) and p values are presented in Table A-14. Significant relationships were defined as a p value of less than 0.05. There was a strong correlation between all media for ^{241}Am except carcass/vegetation comparisons. The carcass/off-mound comparison yielded the only non-significant correlation for ^{238}Pu. For ^{239}Pu the carcass/off-mound soil and mound soil/off-mound soil relationships were the only strong correlations. ^{3}H was inconsistent, displaying strong relationships between carcass/pelt, carcass/mound soil, vegetation/off-mound soil, and pelt/mound soil. Although no significant differences

were detected between sites for the total U data, strong correlations were noted for carcass/mound soil data and vegetation/off-mound soil. As one might expect, the relationship between gopher pelts and carcasses with regard to radionuclide concentrations was quite variable. On average, gopher carcasses contained 51% of the total U level in pelts; this same ratio for the radionuclides was 285% for ^{241}Am, 87% for ^{238}Pu, 575% for ^{239}Pu, and 88% for ^{3}H.

Low sample sizes and variation in environmental conditions may have affected the statistical declaration of true relationships, and the chemical analyses of ^{241}Am suffered quality control problems. The ^{238}Pu data appear to be the most useful in predicting media concentrations.

6.0 Conclusions

In general, gophers are not transporting radionuclides upward from waste cells at Area G. The bases for this conclusion primarily are that (1) radionuclide concentrations did not differ between mound soil and off-mound soil nor between carcass and off-mound soil and (2) radionuclide concentrations in the sampled environmental media were relatively homogenous. The exception may be ^{3}H at Site 3B. Significantly higher ^{3}H concentrations in gopher carcasses compared to off-mound soil at Site 3B might indicate an active pathway. Exceptions to this may occur such as the one cited concerning U at the TRU shafts which occurred after this study was completed.

^{241}Am, ^{238}Pu, and ^{3}H concentrations at Area G were statistically higher than background concentrations, however, only one site within Area G had ^{3}H concentrations sufficient to transfer a dose to gophers that may impact their health. The contaminated topsoil spread over Disposal Pit #6 was the most likely source of the elevated levels of Am and Pu in the environmental media at Sites 1A and 1B. Correlations of radionuclide concentrations across media were highest for ^{241}Am and ^{238}Pu, however only the ^{238}Pu relationship may be true enough to be used in predicting concentrations.

Further investigation through modeling and monitoring is necessary to determine if the ^{3}H shafts are a source of environmental ^{3}H levels that are of ecological concern. Data from this report may aid in modeling the transport of radionuclides through ecological receptors within Area G. This should include investigations of transfer to carnivores.

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APPENDIX A

Summary Data and Statistical Analyses Results

Table A-1. Summary of the Waste Cell Characteristics Located Within the Study Sites at Area G

Pit or Shaft #	Open	Closed	Total Vol (m^3)	Total Activity (Ci)	Radionuclides*	Cover Depth
Study Site 1A						
Shaft 13	Sep-60	May-70	3.27	4.88×10^{01}	H-3, Pu-239, U-235, C0-60, Pu-238	0.9 m crushed tuff, 0.5 m concrete
14	Sep-67	Sep-69	0.759	5.93	U-235	0.9 m crushed tuff, 0.5 m concrete
26	Dec-69	Jun-70			Pu-238, U-238	0.9 m crushed tuff, 0.5 m concrete
49	Apr-72	Sep-72	0.02	1.87	MFP, Pu-239	0.9 m crushed tuff, 0.5 m concrete
52	Sep-75	Jun-76	1.98	1.62×10^{02}	MFP, Pu239, U-235, Co-60, MAP, U-233, U-232, U-238	0.9 m crushed tuff, 0.5 m concrete
62	Apr-74	Jan-76	3.54	1.02×10^{-03}	Pu-238, Pu-239	0.9 m crushed tuff, 0.5 m concrete
63	Jan-76	Jan-76	2.347	2.05×10^{-01}	U-12, U-81, U-235, U-238	0.9 m crushed tuff, 0.5 m concrete
69	Aug-77	Aug-77	0.568	2.10×10^{-03}	U-12, U-38	0.9 m crushed tuff, 0.5 m concrete
73	Jan-73	Mar-73	0.34	1.46×10^{2}	MAP, MFP, U-235, U-238, Pu-239	0.9 m crushed tuff, 0.5 m concrete
74	Mar-73	Aug-73	0.927	1.64×10^{2}	MAP, MFP, U-235, U-38, U-81, Pu-239	0.9 m crushed tuff, 0.5 m concrete
83	Feb-78	Apr-78	1.25	16.7	MFP, Np-237, Pu239, U-233, U-235, U-238, H-3, Pu-238	0.9 m crushed tuff, 0.5 m concrete
84	Mar-78	May-78	37.79	57.0	MFP, Pu-239, Pu-238, Am-241, Pu-241, U-235, Pu-242	0.9 m crushed tuff, 0.5 m concrete
86	Sep-77	Oct-77	0.63	1.00×10^{3}	MFP, Pu-239, U-235	0.9 m crushed tuff, 0.5 m concrete
89	Dec-77	Jan-78	0.814	19.0	MFP, Po-210, Pu-238, Pu-239, U-235	0.9 m crushed tuff, 0.5 m concrete
90	Jan-78	Jan-78	39.61	7.06	Am-241, MFP, Po-210, Pu-238, Pu-239, U-235, U-238, Pu-241, U-234, Pu-242, Pu-241	0.9 m crushed tuff, 0.5 m concrete
97	Jul-78	Apr-84	6.81	1.36×10^{2}	MFP, H-3, Map, Co-60, Am-241, Cs-137, Pu-239, Pu-238,	0.9 m crushed tuff, 0.5 m concrete
100	May-83	Jun-83	45.37	3.71×10^{2}	Am-241, MAP, MFP, Pu-238, Pu-239	0.9 m crushed tuff, 0.5 m concrete
105	May-82	May-83	5.56	1.77×10^{-3}	Am-241, C0-57, Hg-203, Mn-54, Na-22, Pu-239, Pu-238, other	0.9 m crushed tuff, 0.5 m concrete

Table A-1. cont.

Pit or Shaft #	Open	Closed	Total Vol (m^3)	Total Activity (Ci)	Radionuclides	Cover Depth
109	Mar-80	Jul-80	2.33	20.9	Pu-238, Pu-239, MFP, MAP	0.9 m crushed tuff, 0.5 m concrete
110	Feb-79	Nov-79	3.59	459	Cs-137, H-3, MAP, MFP, Pu-239, Pu-238, U-238, U-235	0.9 m crushed tuff, 0.5 m concrete
125	Oct-84	Dec-84	16.9	11.9	MAP, Th-88, U-238	0.9 m crushed tuff, 0.5 m concrete
Study Site 1B						
15	Nov-69	Jun-70	0.136	1.75×10^{4}	H-3	0.9 m crushed tuff, 0.5 m concrete
16	Nov-69	Nov-69	0.113	1.75×10^{4}	H-3	0.9 m crushed tuff, 0.5 m concrete
17	Mar-71	Dec-74	0.329	2.02×10^{4}	H-3, U-235, U-233, Pu-239, Cs-137, U-238, Pu-238	0.9 m crushed tuff, 0.5 m concrete
18	Jul-70	Apr-79	0.325	89.6	Cs-137, Ba-140, Pu-238, U-238, MAP, MFP, Co-60,	0.9 m crushed tuff, 0.5 m concrete
19	Oct-71	Apr-74	0.637	0.45	MFP, U-235	0.9 m crushed tuff, 0.5 m concrete
20	May-74	Jun-75	0.076	3.20×10^{-2}	MFP	0.9 m crushed tuff, 0.5 m concrete
21	Jan-85	Jan-85	4.0×10^{-3}	9.49×10^{-6}	Cf-252	0.9 m crushed tuff, 0.5 m concrete
22	Aug-80	May-93	1.95×10^{-1}	4.88×10^{-2}	22 radionuclides including: Co-60, Na-22, Kr-85, Cs-137, Sr-90, Ba-133, U-235, U-238, Pu-239	0.9 m crushed tuff, 0.5 m concrete
23	Apr-80	Apr-80	2.80×10^{-2}	5.62×10^{2}	Cs-137, Co-60, Ir-192	0.9 m crushed tuff, 0.5 m concrete
35	Sep-71	Jul-85	2.69	35.1	H-3, MFP	0.9 m crushed tuff, 0.5 m concrete
36	Jun-70	Mar-85	7.95×10^{-1}	116	MFP	0.9 m crushed tuff, 0.5 m concrete
37	Jun-70	Oct-85	3.8	0	none	0.9 m crushed tuff, 0.5 m concrete
38	Jun-70	Feb-74	0.114	1.20×10^{-2}	MAP	0.9 m crushed tuff, 0.5 m concrete
pit 6	Jan-70	Aug-72	TRU: 19	TRU: 60	Mostly Pu-238, -239	0.9 m crushed tuff, 0.1 m topsoil
pit 7	Mar-74	Sep-78	3.26×10^{3}	20.4	Am-241, Co-60, Cs-137, Pu-238 to -242, Sr-90, U-235	0.9 m crushed tuff, 0.1 m topsoil
pit 17	Aug-72	Mar-74	3.81×10^{3}	7.00×10^{-2}	Ac-227	0.9 m crushed tuff, 0.1 m topsoil

Table A-1. cont.

Pit or Shaft #	Open	Closed	Total Vol (m^3)	Total Activity (Ci)	Radionuclides	Cover Depth
Study Site 2						
pit 18	Feb-78	Oct-79	9.55×10^3	3.00×10^4	42 radionuclides Including: Am-241, C-14, Co-60, Cs-137, H-3, I-129, Pu-238–242, Sr-90, U-234–238	0.9 m crushed tuff, 0.1 m topsoil
pit 20	Nov-75	Oct-77	1.14×10^4	6.3	38 radionuclides including: Cs-137, H-3, I-129, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Sr-90, U-235	0.9 m crushed tuff, 0.1 m topsoil
Study Site 3A						
trench A	Mar-74	Nov-74	132.38	3.70×10^4	heat source Pu-238 (80% Pu-238, 16% Pu-239, Pu-240, other); ave 18 g Pu-238/cask	Cask lid sealed with asphalt; corrugated "Q-decking" placed on top; covered with 1 m crushed tuff
trench B	Mar-74	Sep-76	93.58	3.19×10^4	heat source Pu-238 (80% Pu-238, 16% Pu-239, Pu-240, other); U-233, ave 18 g Pu-238/cask	Cask lid sealed with asphalt; corrugated "Q-decking" placed on top; covered with 1 m crushed tuff
Study Site 3B						
H-3 shafts	Jan-71	Sep-88	140	8.00×10^5	H-3	0.9 m crushed tuff, 0.5 m concrete
H-3 shafts	Sep-88	Dec-95	54.0	4.30×10^5	H3-	0.9 m crushed tuff, 0.5 m concrete

* MFP = mixed fission products and MAP = mixed activation products

Table A-2. Maximum Distance Vegetation Samples taken from Mound

Site	1A	1B	2	3A	3B
Maximum Distance (m)	2.0	1.5	1.8	1.5	1.8
	1.7	2.7	2.1	1.5	3.0
	2.0	2.1	2.0	1.5	1.4

Table A-3. Summary of Gopher Weights (g) and Weight Ratios Captured at Study Sites

Treatment*	Wet Wt.	Dry Wt.	Ash Wt.	Dry/Wet	Ash/Wet	Ash/Dry
P 1A-1	14.6	5.58	0.67	0.382	0.046	0.120
P 1A-2	14.68	4.95	0.51	0.337	0.035	0.103
P 1A-3	30.44	10.69	1.48	0.351	0.049	0.138
P 1A-4	22.22	9.05	0.7	0.407	0.032	0.077
C 1A-1	89.12	22.56	4.97	0.253	0.056	0.220
C 1A-2	91.1	22.17	5.09	0.243	0.056	0.230
C 1A-3	146.14	36.89	8.46	0.252	0.058	0.229
C 1A-4	118.73	32.24	6.54	0.272	0.055	0.203
P 1B-1	32.96	12.31	1.22	0.373	0.037	0.099
P 1B-2	25.44	9.42	1.14	0.370	0.045	0.121
P 1B-3	26.5	9.01	1.06	0.340	0.040	0.118
P 1B-4	30.6	12.87	2.55	0.421	0.083	0.198
C 1B-1	149.19	41.88	9.64	0.281	0.065	0.230
C 1B-2	121.92	33.58	7.08	0.275	0.058	0.211
C 1B-3	111.81	28.43	5.36	0.254	0.048	0.189
C 1B-4	129.96	35.75	7.49	0.275	0.058	0.210
P 2-1	22.43	7.76	1.03	0.346	0.046	0.133
P 2-2	24.64	8.25	0.87	0.335	0.035	0.105
P 2-3	17.76	5.83	0.41	0.328	0.023	0.070
P 2-4	18.5	7.39	0.36	0.399	0.019	0.049
C 2-1	107.71	28.78	6.39	0.267	0.059	0.222
C 2-2	116.99	31.6	7.16	0.270	0.061	0.227
C 2-3	100.05	24.68	4.84	0.247	0.048	0.196
C 2-4	127.08	33.82	6.97	0.266	0.055	0.206
P 3A-1	30.02	9.39	1.43	0.313	0.048	0.152
P 3A-2	17.52	6.09	0.9	0.348	0.051	0.148
P 3A-3	24.33	6.8	0.4	0.279	0.016	0.059
P 3A-4	19.02	7.26	1.78	0.382	0.094	0.245
C 3A-1	143.17	35.41	7.9	0.247	0.055	0.223
C 3A-2	92.29	24.75	5.79	0.268	0.063	0.234
C 3A-3	128.24	33.22	7.72	0.259	0.060	0.232
C 3A-4	91.12	23.66	5.26	0.260	0.058	0.222

Table A-3. cont.

Treatment*	Wet Wt.	Dry Wt.	Ash Wt.	Dry/Wet	Ash/Wet	Ash/Dry
P 3B-1	18.43	5.99	0.36	0.325	0.020	0.060
P 3B-2	21.37	6.72	1.14	0.314	0.053	0.170
P 3B-3	18.68	6.07	0.92	0.325	0.049	0.152
P 3B-4						
C 3B-1	105.6	26.05	5.69	0.247	0.054	0.218
C 3B-2	101.41	26.19	6.24	0.258	0.062	0.238
C 3B-3	103.91	25.78	5.36	0.248	0.052	0.208
C 3B-4	-	-	-	-	-	-
P Cont. 1	18.35	7.99	0.58	0.435	0.032	0.073
P Cont. 2	13.17	4.13	0.3	0.314	0.023	0.073
P Cont. 3	21.35	7.51	1.37	0.352	0.064	0.182
P Comp.	68.06	26.52	4.23	0.390	0.062	0.160
C Cont. 1	99.41	27.07	5.62	0.272	0.057	0.208
C Cont. 2	75.17	19.32	4.59	0.257	0.061	0.238
C Cont. 3	97.99	24.46	5.59	0.250	0.057	0.229
C Comp.	315.01	86.49	18.62	0.275	0.059	0.215

* P = pelt, C = carcass, Cont. = control, Comp. = composite

Table A-4. Physical and Chemical Characteristics of Soil

Study Site	% Sand	% Silt	% Clay	Texture	pH	CEC* (meq/100g)	% OM*	BD* (g/cm^3)	EC* (mmos/cm)
1A	65	27	8	sandy loam	8.2	3.2	0.6	1.06	0.6
1B	64	28	8	sandy loam	7.8	9.9	1.0	1.06	0.8
2	54	33	13	sandy loam	7.5	12.3	1.1	1.17	0.8
3A	62	30	8	sandy loam	8.2	7.1	0.9	1.11	1.0
3B	69	25	6	sandy loam	8.0	3.9	0.5	1.21	0.6
Control 1	48	36	16	loam	7.4	20.7	3.6	0.96	0.8
Control 2	53	24	23	sandy clay	7.8	25.0	4.2	1.38	1.2
Control 3	50	39	11	loam	7.1	17.6	7.1	0.89	0.7

* CEC = cation exchange capacity, OM = organic matter, BD = bulk density, EC = electrical conductivity

Table A-5. Student T-tests Between Mound Soil and Off-mound Soil

Study Site	^{241}Am	^{238}Pu	^{239}Pu	^{3}H
1A	1.35 (0.15)	0.77 (0.25)	1.24 (0.15)	-0.08 (0.47)
1B	0.42 (0.35)	-0.57 (0.30)	0.61 (0.29)	X
2	-0.76 (0.25)	-1.26 (0.15)	-1.49 (0.11)	X
3A	X	X	X	-0.73 (0.25)
3B	X	X	X	0.79 (0.24)

X = test was not conducted, p value in ( ), negative value indicates a higher off-mound concentration, positive value indicates a higher mound concentration

Table A-6. Student T-tests Between Carcass and Off-mound Soil

Study Site	^{238}Pu	^{239}Pu	^{3}H
1A	-3.51 (0.02)	X	0.40 (0.35)
1B	-3.97 (0.03)	-4.31 (0.01)	1.40 (0.13)
2	-4.17 (0.01)	-1.27 (0.15)	2.02 (0.07)
3A	-1.10 (0.18)	2.91 (0.02)	-0.51 (0.33)
3B	X	X	2.39 (0.03)

X = test was not conducted, p value in ( ), negative value indicates a higher off-mound concentration, positive value indicates a higher mound concentration

Table A-7. Estimated Dose (rad/day) from Radionuclides to Pocket Gophers Residing at Study Sites within Area G

Study Site	^{241}Am	^{238}Pu	^{239}Pu	^{3}H	U
C	6.66E-06	1.28E-06	9.37E-06	9.32E-06	1.24E-04
1A	1.41E-05	1.90E-05	1.86E-05	3.89E-02	5.22E-05
1B	6.08E-05	2.18E-05	1.02E-04	5.74E-03	6.52E-05
2	3.03E-05	6.23E-06	6.65E-05	3.86E-04	7.25E-05
3A	9.34E-06	2.83E-06	3.53E-05	4.54E-02	5.77E-05
3B	3.04E-06	7.23E-07	1.00E-05	9.09E+00	7.11E-05

Table A-8. Soil and Vegetation Radionuclide Concentrations for 1998 Environmental Surveillance Data (taken from LANL 1999)

8.1 Americium

Comparison Site	Soil (pCi/g dry)	Vegetation (pCi/g ash)
1	0.009	0.019
2	0.007	0.004
7a	0.007	0.873
7b	0.016	0.035

8.2 Pu-238

Comparison Site	Soil (pCi/g dry)	Vegetation (pCi/g ash)
1	0.007	0.004
2	0.003	0.002
7a	0.003	0.009
7b	0.004	0.002

8.3 Pu-239

Comparison Site	Soil (pCi/g dry)	Vegetation (pCi/g ash)
1	0.021	0.011
2	0.016	0.008
7a	0.007	0.073
7b	0.025	0.046

8.4 Tritium

Comparison Site	Soil (pCi/g dry)	Vegetation (pCi/g ash)
1	115	1974
2	148	2624
7a	3.1	18
7b	6.4	23

8.5 Uranium

Comparison Site	Soil (pCi/g dry)	Vegetation (pCi/g ash)
1	3.69	0.61
2	3.75	0.53
7a	4.47	0.70
7b	4.35	1.03

Table A-9. Summary of ^{241}Am Results of the LSD Tests and MVU Estimator. Any two means with different letter are significantly different at the α = 0.05 confidence level.

9.1 Carcass (p = 8.77E-02)

Study Site	LSD	Mean (pCi/g ash)	s
1B	X	0.1863	0.0991
2	X	0.0935	0.0597
1A	X	0.0430	0.0182
3A	X	0.0288	0.0143
Control	X	0.0205	0.0186
3B	X	0.0094	0.0084

X = No significant difference was detected

9.2 Pelts

Study Site	Mean (pCi/g ash) *
Treatment	0.1194
Control	0.0134

*Mean concentration based on non-transformed data with no statistical test applied

9.3 Mound Soil (p = 2.92E-06)

Study Site	LSD	Mean (pCi/g dry)	s
1B	A	0.4708	0.1464
1A	B	0.1651	0.0543
2	C	0.0226	0.0128
3B	CD	0.0089	0.0018
3A	CD	0.0074	0.0010
Control	D	0.0048	0.0003

9.4 Off-Mound Soil (p = 3.19E-05)

Study Site	LSD	Mean (pCi/g dry)	s
1B	A	0.3760	0.0741
1A	B	0.0912	0.0105
2	B	0.0835	0.0617
3A	C	0.0054	0.0004
Control	C	0.0052	0.0012
3B	C	0.0044	0.0011

9.5 Vegetation (p = 3.60E-05)

Study Site	LSD	Mean (pCi/g ash)	s
1B	A	0.2430	0.1108
1A	A	0.1846	0.0402
2	B	0.0187	0.0094
3B	B	0.0088	0.0043
Control	B	0.0045	0.0037
3A	B	0.0019	0.0039

Table A-10. ^{238}Pu Results of the LSD Tests and MVU Estimator. Any two means with different letter are significantly different at the α = 0.05 confidence level.

10.1 Carcass (p = 7.10E-05)

Study Site	LSD	Mean (pCi/g ash)	s
1B	A	0.0669	0.0153
1A	A	0.0583	0.0120
2	B	0.0191	0.0093
3A	BC	0.0087	0.0027
Control	CD	0.0039	0.0019
3B	D	0.0022	0.0016

10.2 Pelts

Study Site	Mean (pCi/g ash)*
Treatment	0.1627
Control	-0.00055

*Mean concentration based on non-transformed data with no statistical test applied

10.3 Mound Soil (p = 2.50E-04)

Study Site	LSD	Mean (pCi/g ash)	s
1B	A	0.8118	0.5372
1A	AB	0.2195	0.1310
2	BC	0.0614	0.0532
3B	CD	0.0038	0.0008
3A	CD	0.0022	0.0004
C	D	0.0006	0.0003

10.4 Off-Mound Soil (p = 6.42E-05)

Study Site	LSD	Mean (pCi/g ash)	s
1B	A	2.4541	1.9002
2	B	0.1593	0.0925
1A	B	0.0909	0.0394
3B	C	0.0061	0.0018
3A	C	0.0051	0.0028
C	C	0.0014	0.0005

10.5 Vegetation (p = 9.02E-06)

Study Site	LSD	Mean (pCi/g ash)	s
1B	A	0.1509	0.0557
1A	AB	0.0403	0.0050
2	B	0.0342	0.0173
3B	C	0.0040	0.0006
Control	C	0.0022	0.0015
3A	C	0.0012	0.0006

Table A-11. ^{239}Pu Results of the LSD Tests and MVU Estimator. Any two means with different letter are significantly different at the α = 0.05 confidence level.

11.1 Carcass (p = 4.91E-03)

Study Site	LSD	Mean (pCi/g ash)	s
1B	A	0.3330	0.1686
2	AB	0.2174	0.0881
3A	AB	0.1155	0.0303
1A	BC	0.0609	0.0039
3B	C	0.0328	0.0203
Control	C	0.0306	0.0116

11.2 Pelts

Study Site	Mean (pCi/g ash)*
Treatment	0.162
Control	0.00805

*Mean concentration based on non-transformed data with no statistical test applied

11.3 Mound Soil (p = 6.89E-06)

Study Site	LSD	Mean (pCi/g dry)	s
1B	A	0.6890	0.2026
1A	A	0.2820	0.0902
2	B	0.0355	0.0194
3B	BC	0.0104	0.0049
Control	C	0.0068	0.0014
3A	C	0.0043	0.0018

11.4 Off-Mound Soil (p = 4.28E-05)

Study Site	LSD	Mean (pCi/g dry)	s
1B	A	0.5232	0.0695
2	A	0.3078	0.2278
1A	A	0.1645	0.0250
C	B	0.0108	0.0042
3A	B	0.0074	0.0024
3B	B	0.0038	0.0018

11.5 Vegetation (p = 2.01E-05)

Study Site	LSD	Mean (pCi/g ash)	s
1A	A	0.2961	0.2032
1B	A	0.1499	0.0673
2	A	0.0759	0.0246
3A	B	0.0082	0.0008
3B	B	0.0071	0.0013
Control	B	0.0061	0.0023

Table A-12. Total U Results of the LSD Tests and MVU Estimator. Any two means with different letter are significantly different at the $\alpha = 0.05$ confidence level.

12.1 Carcass

Study Site	Mean (pCi/g ash)	s
Control	0.4981	0.2037
3B	0.2867	0.0192
2	0.2920	0.0597
1B	0.2629	0.0314
3A	0.2325	0.0164
1A	0.2102	0.0336

12.2 Pelts

Study Site	Mean (pCi/g ash)*
Treatment	0.69
Control	0.655

*Mean concentration based on non-transformed data with no statistical test applied

12.3 Mound Soil

Study Site	Mean (pCi/g dry)	s
Control	3.5260	0.7125
1B	2.6201	0.1022
2	2.4054	0.2828
3B	2.3598	0.1632
3A	2.3360	0.2428
1A	2.3170	0.2054

12.4 Off-Mound Soil

Study Site	Mean (pCi/g dry)	s
2	9.6571	6.2842
Control	3.2266	0.6789
1A	2.9718	0.5136
3A	2.8266	0.1241
3B	2.7400	0.1937
1B	2.6067	0.0873

12.5 Vegetation

Study Site	Mean (pCi/g ash)	s
2	1.3756	0.6688
3B	1.0534	0.0934
3A	0.5100	0.0583
Control	0.6113	0.1433
1B	0.4639	0.1228
1A	0.4113	0.0920

Table A-13. ^{3}H Results of the LSD Tests and MVU Estimator. Any two means with different letter are significantly different at the $\alpha = 0.05$ confidence level.

13.1 Carcass (p = 1.20E-07)

Study Site	LSD	Mean (pCi/L)	s
3B	A	1.68E+08	1.38E+08
3A	B	8.38E+05	4.69E+05
1A	B	7.18E+05	5.79E+05
1B	B	1.06E+05	5.06E+04
2	C	7.12E+03	1.18E+03
Control	D	1.72E+02	2.36E+02

13.2 Pelts (p = 2.69E-07)

Study Site	LSD	Mean (pCi/L)	s
3B	A	1.43E+08	1.13E+08
3A	B	8.18E+05	4.57E+05
1A	B	6.60E+05	5.23E+05
1B	BC	1.01E+05	4.82E+04
2	CD	8.30E+03	7.55E+02
Control	D	1.93E+03	6.65E+02

13.3 Mound Soil (p = 0.0010)

Study Site	LSD	Mean (pCi/L)	s
3B	A	5.61E+07	5.31E+07
3A	AB	1.14E+06	1.02E+06
1A	BC	1.19E+05	6.32E+04
1B	CD	7.07E+03	8.28E+02
2	CD	6.31E+03	2.81E+03
Control	D	1.34E+02	3.62E+02

13.4 Off-Mound Soil (p = 0.0029)

Study Site	LSD	Mean (pCi/L)	s
3A	A	2.07E+07	1.99E+07
3B	A	2.24E+06	1.63E+06
1A	AB	2.31E+05	1.77E+05
1B	BC	3.69E+04	3.12E+04
2	BC	3.86E+03	1.18E+03
Control	C	3.47E+02	5.02E+01

13.5 Vegetation (p = 6.15E-06)

Study Site	LSD	Mean (pCi/L)	s
3A	A	5.22E+08	5.12E+08
3B	A	3.43E+08	3.31E+08
1A	AB	1.93E+06	1.25E+06
1B	BC	9.55E+04	6.81E+04
2	CD	1.74E+04	5.64E+03
Control	D	2.06E+03	1.32E+03

Table A-14. Summary of Correlation Tests between Environmental Media. A significant relationship exists at $p \leq 0.05$.

14.1 Am Correlations

Variables	r	p
Carcass / Mound	0.87	0.012
Carcass / Off-mound	0.96	0.001
Carcass / Vegetation	0.72	0.054
Mound / Off-mound	0.97	0.0005
Mound / Vegetation	0.93	0.0036
Off-mound / Vegetation	0.86	0.015

14.2 Pu-238 Correlations

Variables	r	p
Carcass / Mound	0.85	0.015
Carcass / Off-mound	0.71	0.056
Carcass / Vegetation	0.84	0.018
Mound / Off-mound	0.97	0.0006
Mound / Vegetation	0.99	0.0001
Off-mound / Vegetation	0.97	0.0007

14.3 Pu-239 Correlations

Variables	r	p
Carcass / Mound	0.72	0.053
Carcass / Off-mound	0.93	0.0039
Carcass / Vegetation	0.20	0.349
Mound / Off-mound	0.84	0.019
Mound / Vegetation	0.61	0.101
Off-mound / Vegetation	0.48	0.168

14.4 Tritium Correlations

Variables	r	p
Carcass / Pelt	0.999	3.89 x 10 - 14
Carcass / Mound	0.999	1.17 x 10 - 8
Carcass / Off-mound	-0.093	0.431
Carcass / Vegetation	0.426	0.199
Pelt / Mound	0.999	1.01 x 10 - 8
Pelt / Off-mound	-0.092	0.431
Pelt / Vegetation	0.426	0.199
Mound / Off-mound	-0.077	0.442
Mound / Vegetation	0.440	0.191
Off-mound / Vegetation	0.861	0.014

14.5 Uranium Correlations

Variables	r	p
Carcass / Mound	0.95	0.002
Carcass / Off-mound	0.03	0.478
Carcass / Vegetation	0.10	0.424
Mound / Off-mound	-0.14	0.393
Mound / Vegetation	-0.19	0.362
Off-mound / Vegetation	0.80	0.029

APPENDIX B

Original Analytical Reports

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: AM RAS ENV **Method Area:** EH-ALPHA **Submission Id :** 100032162

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175208	1AAM-1	Am-241	0.1298	0.0068	pCi/g	
			Am-243T Recovery	45.20		%	
200073784	300175212	1AAM-2	Am-241	0.0874	0.0051	pCi/g	
			Am-243T Recovery	53.98		%	
200073785	300175216	1AAM-3	Am-241	0.2814	0.0105	pCi/g	
			Am-243T Recovery	55.63		%	
200073786	300175221	1BAM-1	Am-241	0.6429	0.0179	pCi/g	
			Am-243T Recovery	62.54		%	
200073787	300175224	1BAM-2	Am-241	0.2250	0.0087	pCi/g	
			Am-243T Recovery	60.66		%	
200073788	300175228	1BAM-3	Am-241	0.5316	0.0209	pCi/g	
			Am-243T Recovery	44.99		%	
200073789	300175232	2AM-1	Am-241	0.0563	0.0052	pCi/g	
			Am-243T Recovery	40.72		%	
200073790	300175235	2AM-2	Am-241	0.0088	0.0014	pCi/g	
			Am-243T Recovery	80.56		%	
200073791	300175240	2AM-3	Am-241	0.0074	0.0014	pCi/g	
			Am-243T Recovery	65.32		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100032162

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073792	300175244	3AAM-1	Am-241	0.0066	0.0013	pCi/g	
			Am-243T Recovery	70.81		%	
200073793	300175248	3AAM-2	Am-241	0.0062	0.0012	pCi/g	
			Am-243T Recovery	67.03		%	
200073794	300175252	3AAM-3	Am-241	0.0094	0.0019	pCi/g	
			Am-243T Recovery	53.03		%	
200073795	300175256	3BAM-1	Am-241	0.013	0.004	pCi/g	
			Am-243T Recovery	60.86		%	
200073796	300175260	3BAM-2	Am-241	0.0069	0.0014	pCi/g	
			Am-243T Recovery	60.78		%	
200073797	300175264	3BAM-3	Am-241	0.007	0.002	pCi/g	
			Am-243T Recovery	63 23		%	
200073798	300175268	1ABN-1	Am-241	0.0737	0.0048	pCi/g	
			Am-243T Recovery	52.19		%	
200073799	300175272	1ABN-2	Am-241	0.11	0.02	pCi/g	
			Am-243T Recovery	28.61		%	
200073800	300175276	1ABN-3	Am-241	0.09	0.01	pCi/g	
			Am-243T Recovery	37.41		%	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175208		Am-241	0.1298	0.0068	pCi/g	
			Am-243T Recovery	45.20		%	
200081418	300189319	300175208	Am-241	0.1377	0.0072	pCi/g	
			Am-243T Recovery	47.87		%	
200073794	300175252		Am-241	0.0094	0.0019	pCi/g	
			Am-243T Recovery	53.03		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100032162

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200081419	300189320	300175252	Am-241	0.004	0.004	pCi/g	
			Am-243T Recovery	60.0		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100032162

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073803	300175283	Am-241	0.32	0.03	pCi/g	0.30	0.01	pCi/g	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300189321	Am-241	0.003	0.0012	pCi/g	0.0	0.0	pCi/g	WARNING 2-3SIG

CC1030

**** FINAL REPORT ****

AMERICIUM
CST-9 Inorganic Trace Analysis
Request No: R32162
Owner: GG
COST M34A02012A00

Prepared By: JH
Date Aliquoted: 9/24/98
Balance ID:645288

XXXX XXXX	Sample ID:	Sample Matrix	Sample Wt(g)/Vol(ml)	XXXXX XXXXX	Comments	XXXXXX XXXXXX
XXXXX	200073783	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073784	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073785	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073786	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073787	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073788	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073789	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073790	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073791	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073792	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073793	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073794	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073795	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073796	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073797	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073798	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073799	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073800	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073803	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073838Pdup	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073794Pdup	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	0.22776	SS	xxxxxx	XXXXX	pblank	XXXXXXX

1 ml Am^{243} LLC-4-a @ 5.36 pCi/ml by RJP on 5.0.98

CC1.0

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: AM RAS ENV **Method Area:** EH-ALPHA **Submission Id :** 100033135

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A0201SA00	**Due Date:**	23-DEC-98
Requester Group:	ESH-20	**Logged Date:**	20-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077849	300182896	GSAM	Am-241	0.0052	0.0012	pCi/g	
			Am-243T Recovery	54.95		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033135

********** CST QUALITY ASSURANCE REPORT **********

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300192780	Am-241	0.0019	0.0009	pCi/g	0.0	0.0	pCi/g	WARNING 2-3SIG

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100032167

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV 98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073830	300175322	1BBN-1	Am-241	0.53	0.04	pCi/g	
			Am-243T Recovery	48.95		%	
200073831	300175327	1BBN-2	Am-241	0.27	0.04	pCi/g	
			Am-243T Recovery	73.13		%	
200073832	300175332	1BBN-3	Am-241	0.33	0.02	pCi/g	
			Am-243T Recovery	55.61		%	
200073833	300175337	2BN-1	Am-241	0.26	0.02	pCi/g	
			Am-243T Recovery	55.62		%	
200073834	300175342	2BN-2	Am-241	0.011	0.004	pCi/g	
			Am-243T Recovery	67.59		%	
200073835	300175347	2BN-3	Am-241	0.019	0.005	pCi/g	
			Am-243T Recovery	60.06		%	
200073836	300175352	3ABN-1	Am-241	0.0050	0.0013	pCi/g	
			Am-243T Recovery	59.06		%	
200073837	300175357	3ABN-2	Am-241	0.0063	0.0014	pCi/g	
			Am-243T Recovery	66.53		%	
200073838	300175362	3ABN-3	Am-241	0.005	0.003	pCi/g	
			Am-243T Recovery	60.0		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100032167

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073839	300175370	3BBN-1	Am-241	0.0067	0.0023	pCi/g	
			Am-243T Recovery	26.36		%	
200073840	300175372	3BBN-2	Am-241	0.0027	0.0010	pCi/g	
			Am-243T Recovery	62.95		%	
200073841	300175377	3BBN-3	Am-241	0.0038	0.0012	pCi/g	
			Am-243T Recovery	56.07		%	
200073842	300175382	JSAM	Am-241	0.0050	0.0018	pCi/g	
			Am-243T Recovery	47.01		%	
200073843	300175387	JSBN	Am-241	0.0078	0.0016	pCi/g	
			Am-243T Recovery	54.63		%	
200073844	300175392	CAM	Am-241	0.0041	0.0016	pCi/g	
			Am-243T Recovery	52.40		%	
200073845	300175397	CBN	Am-241	0.0039	0.0015	pCi/g	
			Am-243T Recovery	58.33		%	
200073846	300175402	GSN	Am-241	0.0040	0.0012	pCi/g	
			Am-243T Recovery	53.63		%	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200073830	300175322		Am-241	0.53	0.04	pCi/g	
			Am-243T Recovery	48.95		%	
200086571	300197604	300175322	Am-241	0.69	0.05	pCi/g	
			Am-243T Recovery	40.17		%	
200073838	300175362		Am-241	0.005	0.003	pCi/g	
			Am-243T Recovery	60.0		%	
200086572	300197605	300175362	Am-241	0.0018	0.0008	pCi/g	
			Am-243T Recovery	58.07		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100032167

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073847	300175407	Am-241	0.2071	0.0100	pCi/g	0.206	0.009	pCi/g	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300197606	Am-241	0.0096	0.0044	pCi/g	0.0	0.0	pCi/g	WARNING 2-3SIG

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100032167

Analyst	Review	Team Leader	QA Officer
RJP			
26 JAN 99	1/27/99	1/27/99	1/28/99
Date	Date	Date	Date

The control status of the preceeding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level unless otherwise stated."

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	08-JAN-99
Requester Group:	ESH-20	**Logged Date:**	28-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	667-6630			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078597	300184406	V 1A-1	Am-241	0.2691	0.0159	pCi/g	
			Am-243T Recovery	75.58		%	
			Analysis Date	03/03/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	31.73		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	437.		counts	
			Am-241 Background Counts	7.2		counts	
200078617	300184409	V 1A-2	Am-241	0.1279	0.0124	pCi/g	
			Am-243T Recovery	38.35		%	
			Analysis Date	02/16/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	28.60		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	200.		counts	
			Am-241 Background Counts	13.2		counts	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078618	300184412	V 1A-3	Am-241	0.1579	0.0147	pCi/g	
			Am-243T Recovery	28.26		%	
			Analysis Date	02/16/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	29.85		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	188.		counts	
			Am-241 Background Counts	10.6		counts	
200078619	300184415	V 1B-1	Am-241	0.5164	0.0225	pCi/g	
			Am-243T Recovery	50.31		%	
			Analysis Date	02/16/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.60		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	1063.		counts	
			Am-241 Background Counts	4.2		counts	
200078620	300184420	V 1B-2	Am-241	0.1088	0.0100	pCi/g	
			Am-243T Recovery	36.10		%	
			Analysis Date	02/16/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	32.92		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	177.		counts	
			Am-241 Background Counts	4.8		counts	
200078621	300184421	V 1B-3	Am-241	0.1269	0.0100	pCi/g	
			Am-243T Recovery	90.58		%	
			Analysis Date	03/03/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078621	300184421	V 1B-3	Count Time	3000.00		min	
			Efficiency	29.96		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	240.		counts	
			Am-241 Background Counts	10.6		counts	
200078622	300184424	V 2-1	Am-241	0.0355	0.0061	pCi/g	
			Am-243T Recovery	34.13		%	
			Analysis Date	02/16/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.74		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	56.		counts	
			Am-241 Background Counts	6.4		counts	
200078623	300184427	V 2-2	Am-241	0.0043	0.0072	pCi/g	
			Am-243T Recovery	31.91		%	
			Analysis Date	03/03/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.63		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	7.		counts	
			Am-241 Background Counts	4.2		counts	
200078624	300184430	V 2-3	Am-241	0.0160	0.0044	pCi/g	
			Am-243T Recovery	69.02		%	
			Analysis Date	03/03/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	32.97		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	29.		counts	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078624	300184430	V 2-3	Am-241 Background Counts	4.8		counts	
200078625	300184433	V 3A-1	Am-241	0.0004	0.0038	pCi/g	
			Am-243T Recovery	46.93		%	
			Analysis Date	03/03/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.40		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	6.		counts	
			Am-241 Background Counts	5.6		counts	
200078626	300184436	V 3A-2	Am-241	0.0085	0.0040	pCi/g	
			Am-243T Recovery	39.09		%	
			Analysis Date	02/16/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	28.03		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	19.		counts	
			Am-241 Background Counts	6.6		counts	
200078627	300184439	V 3A-3	Am-241	-0.0037	0.0073	pCi/g	
			Am-243T Recovery	18.61		%	
			Analysis Date	03/03/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.67		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	5.		counts	
			Am-241 Background Counts	6.4		counts	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200078631	300184443	Am-241	8.4662	0.2392	pCi/g	7.98	0.36	pCi/g	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.41404	300204132	Am-241	2677	1204	pCi/L	0.0023	0.00023	pCi/L	WARNING 2-3SIG
00.41404	300204134	Am-241	2676	1134	pCi/L	0.0023	0.00023	pCi/L	WARNING 2-3SIG

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22784	300204131	Am-241	0.0013	0.0038	pCi/g	0	0	pCi/g	IN CONTROL
00.22784	300204133	Am-241	0.0148	0.0082	pCi/g	0	0	pCi/g	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: AM RAS ENV **Method Area:** EH-ALPHA **Submission Id :** 100033001

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-DEC-98
Requester Group:	ESH-20	**Logged Date:**	16-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6091			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077557	300182450	P-1A	Am-241	0.2598	0.0248	pCi/g	
			Am-243T Recovery	30.64		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	31.54		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	177.		counts	
			Am-241 Background Counts	9.8		counts	
200077562	300182455	P-1B	Am-241	0.3273	0.0320	pCi/g	
			Am-243T Recovery	29.43		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	28.80		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	198.		counts	
			Am-241 Background Counts	13.2		counts	

****** FINAL REPORT ******

Method: AM RAS ENV **Method Area: EH-ALPHA** **Submission Id : 100033001**

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077563	300182460	P-2	Am-241	0.0084	0.0090	pCi/g	
			Am-243T Recovery	20.95		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.04		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	15.		counts	
			Am-241 Background Counts	10.2		counts	
200077564	300182465	P-3A	Am-241	0.0056	0.0071	pCi/g	
			Am-243T Recovery	16.63		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.38		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	8.		counts	
			Am-241 Background Counts	4.2		counts	
200077565	300182470	P-3B	Am-241	-0.0041	0.0094	pCi/g	
			Am-243T Recovery	15.53		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	32.89		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	4.		counts	
			Am-241 Background Counts	5.4		counts	
200077566	300182475	P-COMB1	Am-241	0.0045	0.0050	pCi/g	
			Am-243T Recovery	50.39		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	

****** FINAL REPORT ******

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077566	300182475	P-COMB1	Count Time	3000.00		min	
			Efficiency	30.43		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	11.		counts	
			Am-241 Background Counts	6.4		counts	
200077567	300182480	P-COMB2	Am-241	0.0223	0.0261	pCi/g	
			Am-243T Recovery	6.16		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.63		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	8.		counts	
			Am-241 Background Counts	5.2		counts	
200077568	300182485	C-1A-1	Am-241	0.0075	0.0159	pCi/g	
			Am-243T Recovery	18.10		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.99		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	12.		counts	
			Am-241 Background Counts	9.2		counts	
200077569	300182490	C-1A-2	Am-241	0.0578	0.0063	pCi/g	
			Am-243T Recovery	51.62		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.36		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	127.		counts	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077569	300182490	C-1A-2	Am-241 Background Counts	5.8		counts	
200077570	300182495	C-1A-3	Am-241	0.0304	0.0050	pCi/g	
			Am-243T Recovery	88.97		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.20		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	63.		counts	
			Am-241 Background Counts	8.6		counts	
200077571	300182500	C-1A-4	Am-241	0.0710	0.0098	pCi/g	
			Am-243T Recovery	53.59		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.05		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	81.		counts	
			Am-241 Background Counts	4.8		counts	
200077572	300182505	C-1B-1	Am-241	0.0295	0.0130	pCi/g	
			Am-243T Recovery	20.13		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	28.30		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	16.		counts	
			Am-241 Background Counts	4.8		counts	
200077573	300182510	C-1B-2	Am-241	0.5465	0.0327	pCi/g	
			Am-243T Recovery	25.44		%	
			Analysis Date	01/28/99		MM/DD/YY	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077573	300182510	C-1B-2	Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.62		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	576.		counts	
			Am-241 Background Counts	6.0		counts	
200077574	300182515	C-1B-3	Am-241	0.0902	0.0077	pCi/g	
			Am-243T Recovery	50.57		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	31.34		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	193.		counts	
			Am-241 Background Counts	2.6		counts	
200077575	300182520	C-1B-4	Am-241	0.1173	0.0210	pCi/g	
			Am-243T Recovery	18.33		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	32.39		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	50.		counts	
			Am-241 Background Counts	3.6		counts	
200077576	300182524	C-2-1	Am-241	0.0585	0.0143	pCi/g	
			Am-243T Recovery	31.27		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.72		%	
			Am-243T Spike	2.05		pCi	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077576	300182524	C-2-1	Am-241 Gross Counts	44.		counts	
			Am-241 Background Counts	6.6		counts	
200077577	300182530	C-2-2	Am-241	0.3335	0.0337	pCi/g	
			Am-243T Recovery	40.31		%	
			Analysis Date	02/01/99		MM/DD/YY	
			Instrument	80 ALPHA		NONE	
			Count Time	1333.33		min	
			Efficiency	20.86		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	169.		counts	
			Am-241 Background Counts	3.0		counts	
200077578	300182535	C-2-3	Am-241	0.0093	0.0171	pCi/g	
			Am-243T Recovery	10.74		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	32.96		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	10.		counts	
			Am-241 Background Counts	7.8		counts	
200077579	300182540	C-2-4	Am-241	0.0172	0.0148	pCi/g	
			Am-243T Recovery	15.57		%	
			Analysis Date	03/29/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	31.33		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	13.		counts	
			Am-241 Background Counts	7.4		counts	
200077580	300182545	C-3A-1	Am-241	0.0135	0.0038	pCi/g	
			Am-243T Recovery	89.04		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077580	300182545	C-3A-1	Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	31.54		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	35.		counts	
			Am-241 Background Counts	9.8		counts	
200077581	300182549	C-3A-2	Am-241	0.0216	0.0079	pCi/g	
			Am-243T Recovery	62.21		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	28.80		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	39.		counts	
			Am-241 Background Counts	13.2		counts	
200077582	300182555	C-3A-3	Am-241	0.0797	0.0081	pCi/g	
			Am-243T Recovery	90.98		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.08		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	155.		counts	
			Am-241 Background Counts	9.8		counts	
200077583	300182560	C-3A-4	Am-241	0.0048	0.0124	pCi/g	
			Am-243T Recovery	12.14		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.75		%	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077583	300182560	C-3A-4	Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	5.		counts	
			Am-241 Background Counts	3.8		counts	
200077584	300182563	C-3B-1	Am-241	0.0305	0.0066	pCi/g	
			Am-243T Recovery	51.81		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	32.89		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	40.		counts	
			Am-241 Background Counts	5.4		counts	
200077585	300182570	C-3B-2	Am-241	0.0011	0.0085	pCi/g	
			Am-243T Recovery	27.45		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.43		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	7.		counts	
			Am-241 Background Counts	6.4		counts	
200077586	300182575	C-3B-3	Am-241	-0.0012	0.0154	pCi/g	
			Am-243T Recovery	8.45		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.63		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	5.		counts	
			Am-241 Background Counts	5.2		counts	
200077587	300182580	C-CS	Am-241	0.0201	0.0045	pCi/g	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077587	300182580	C-CS	Am-243T Recovery	98.56		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.99		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	50.		counts	
			Am-241 Background Counts	9.2		counts	
200077588	300182585	C-GS	Am-241	-0.0054	0.0060	pCi/g	
			Am-243T Recovery	23.90		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.20		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	6.		counts	
			Am-241 Background Counts	8.6		counts	
200077589	300182590	C-JS	Am-241	0.0039	0.0027	pCi/g	
			Am-243T Recovery	80.42		%	
			Analysis Date	04/07/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.05		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	11.		counts	
			Am-241 Background Counts	4.8		counts	
200077590	300182595	C-COMB	Am-241	0.0437	0.0086	pCi/g	
			Am-243T Recovery	36.15		%	
			Analysis Date	02/24/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077590	300182595	C-COMB	Efficiency	28.60		%	
			Am-243T Spike	2.05		pCi	
			Am-241 Gross Counts	74.		counts	
			Am-241 Background Counts	13.2		counts	

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200077594	300182597	Am-241	4.3355	0.1203	pCi/g	4.08	0.18	pCi/g	IN CONTROL
200077595	300182601	Am-241	7.3288	0.1946	pCi/g	7.27	0.33	pCi/g	IN CONTROL
200077596	300182599	Am-241	7.8137	0.2917	pCi/g	8.94	0.40	pCi/g	WARNING 2-3SIG

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.41404	300210375	Am-241	0.0026	0.0009	pCi/L	0.0023	0.00023	pCi/L	IN CONTROL
00.41404	300210376	Am-241	0.0025	0.0007	pCi/L	0.0023	0.00023	pCi/L	IN CONTROL

**** FINAL REPORT ****

Method: AM RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22784	300210372	Am-241	0.0006	0.0002	pCi/g	0	0	pCi/g	WARNING 2-3SIG
00.22784	300210373	Am-241	0.0106	0.00378	pCi/g	0	0	pCi/g	WARNING 2-3SIG
00.22784	300210374	Am-241	0.0059	0.0028	pCi/g	0	0	pCi/g	WARNING 2-3SIG

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: PU RAS ENV **Method Area:** EH-ALPHA **Submission Id :** 100032162

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175207	1AAM-1	Pu-238	0.0793	0.0039	pCi/g	
			Pu-239	0.2047	0.0073	pCi/g	
			Pu-242T Recovery	95.52		%	
200073784	300175211	1AAM-2	Pu-238	0.0625	0.0038	pCi/g	
			Pu-239	0.1631	0.0070	pCi/g	
			Pu-242T Recovery	92.49		%	
200073785	300175215	1AAM-3	Pu-238	0.5692	0.0173	pCi/g	
			Pu-239	0.4862	0.0152	pCi/g	
			Pu-242T Recovery	96.32		%	
200073786	300175220	1BAM-1	Pu-238	0.1192	0.0054	pCi/g	
			Pu-239	0.9715	0.0276	pCi/g	
			Pu-242T Recovery	90.77		%	
200073787	300175223	1BAM-2	Pu-238	1.9770	0.0526	pCi/g	
			Pu-239	0.3502	0.0116	pCi/g	
			Pu-242T Recovery	100.74		%	
200073788	300175227	1BAM-3	Pu-238	0.4034	0.0130	pCi/g	
			Pu-239	0.7327	0.0214	pCi/g	
			Pu-242T Recovery	93.96		%	

****** FINAL REPORT ******

Method: PU RAS ENV **Method Area: EH-ALPHA** **Submission Id : 100032162**

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073789	300175231	2AM-1	Pu-238	0.0010	0.0004	pCi/g	
			Pu-239	0.0854	0.0044	pCi/g	
			Pu-242T Recovery	107.48		%	
200073790	300175238	2AM-2	Pu-238	0.0891	0.0040	pCi/g	
			Pu-239	0.0154	0.0015	pCi/g	
			Pu-242T Recovery	99.14		%	
200073791	300175239	2AM-3	Pu-238	0.0395	0.0028	pCi/g	
			Pu-239	0.0117	0.0014	pCi/g	
			Pu-242T Recovery	93.01		%	
200073792	300175243	3AAM-1	Pu-238	0.0021	0.0006	pCi/g	
			Pu-239	0.0072	0.0012	pCi/g	
			Pu-242T Recovery	95.94		%	
200073793	300175247	3AAM-2	Pu-238	0.0029	0.0011	pCi/g	
			Pu-239	0.0015	0.0008	pCi/g	
			Pu-242T Recovery	95.80		%	
200073794	300175251	3AAM-3	Pu-238	0.0015	0.0007	pCi/g	
			Pu-239	0.0041	0.0010	pCi/g	
			Pu-242T Recovery	91.93		%	
200073795	300175255	3BAM-1	Pu-238	0.0048	0.0011	pCi/g	
			Pu-239	0.0212	0.0022	pCi/g	
			Pu-242T Recovery	83.55		%	
200073796	300175259	3BAM-2	Pu-238	0.0024	0.0008	pCi/g	
			Pu-239	0.0036	0.0009	pCi/g	
			Pu-242T Recovery	86.36		%	
200073797	300175263	3BAM-3	Pu-238	0.0041	0.0010	pCi/g	
			Pu-239	0.0070	0.0012	pCi/g	
			Pu-242T Recovery	93.97		%	
200073798	300175267	1ABN-1	Pu-238	0.0345	0.0027	pCi/g	
			Pu-239	0.1311	0.0061	pCi/g	
			Pu-242T Recovery	90.33		%	
200073799	300175271	1ABN-2	Pu-238	0.0677	0.0041	pCi/g	

****** FINAL REPORT ******

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100032162

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073799	300175271	1ABN-2	Pu-239	0.2170	0.0087	pCi/g	
			Pu-242T Recovery	86.98		%	
200073800	300175275	1ABN-3	Pu-238	0.1728	0.0073	pCi/g	
			Pu-239	0.1459	0.0065	pCi/g	
			Pu-242T Recovery	86.54		%	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175207		Pu-238	0.0793	0.0039	pCi/g	
			Pu-239	0.2047	0.0073	pCi/g	
			Pu-242T Recovery	95.52		%	
200079203	300185497	300175207	Pu-238	0.0732	0.0043	pCi/g	
			Pu-239	0.1872	0.0079	pCi/g	
			Pu-242T Recovery	87.75		%	
200073794	300175251		Pu-238	0.0015	0.0007	pCi/g	
			Pu-239	0.0041	0.0010	pCi/g	
			Pu-242T Recovery	91.93		%	
200079204	300185498	300175251	Pu-238	0.0012	0.0005	pCi/g	
			Pu-239	0.0075	0.0011	pCi/g	
			Pu-242T Recovery	101.72		%	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100032162

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073803	300175282	Pu-238	0.9629	0.0284	pCi/g	1.03	0.04	pCi/g	IN CONTROL
		Pu-239	0.2885	0.0105	pCi/g	0.289	0.009	pCi/g	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300185499	Pu-238	0.0012	0.0006	pCi/g	0.0	0.0	pCi/g	WARNING 2-3SIG
		Pu-239	0.0008	0.0005	pCi/g	0.0	0.0	pCi/g	IN CONTROL

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100032162

Analyst	Review	Team Leader	QA Officer
RJP	[signature]	[signature]	NK for PCL
11 Dec 98	12/2/98	12-4-98	12/4/98
Date	Date	Date	Date

The control status of the preceeding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level unless otherwise stated."

**** FINAL REPORT ****

PLUTONIUM
CST-9 Inorganic Trace Analysis
Request No: **R32162**
Owner: GG
COST **M34A02012A00**

Prepared By: JH
Date Aliquoted: 9/29/98
Balance ID:645288

XXXX XXXX	Sample ID:	Sample Matrix	Sample Wt(g)/Vol(ml)	XXXXX XXXXX	Comments	XXXXXX XXXXXX
XXXXX	200073783	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073784	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073785	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073786	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073787	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073788	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073789	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073790	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073791	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073792	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073793	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073794	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073795	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073796	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073797	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073798	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073799	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073800	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073803	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073838Pdup	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	200073794Pdup	SS	10G	XXXXX	BALL MILLED	XXXXXXX
XXXXX	0.22776	SS	xxxxxx	XXXXX	pblank	XXXXXXX

ccc. 16.h 4.13 pCi soct by RJP

CC1022

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: PU RAS ENV **Method Area:** EH-ALPHA **Submission Id :** 100033135

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A0201SA00	**Due Date:**	23-DEC-98
Requester Group:	ESH-20	**Logged Date:**	20-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077849	300182895	GSAM	Pu-238	0.0005	0.0005	pCi/g	
			Pu-239	0.0087	0.0013	pCi/g	
			Pu-242T Recovery	87.76		%	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033135

********** CST QUALITY ASSURANCE REPORT **********

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300190347	Pu-238	-0.0001	0.0002	pCi/g	0.0	0.0	pCi/g	IN CONTROL
		Pu-239	0.0000	0.0003	pCi/g	0.0	0.0	pCi/g	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: PU RAS ENV **Method Area:** EH-ALPHA **Submission Id :** 100032167

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073830	300175323	1BBN-1	Pu-238	0.1602	0.0066	pCi/g	
			Pu-239	0.5289	0.0164	pCi/g	
			Pu-242T Recovery	98.64		%	
200073831	300175328	1BBN-2	Pu-238	6.3864	0.1519	pCi/g	
			Pu-239	0.4025	0.0119	pCi/g	
			Pu-242T Recovery	110.85		%	
200073832	300175333	1BBN-3	Pu-238	0.9281	0.0270	pCi/g	
			Pu-239	0.6378	0.0195	pCi/g	
			Pu-242T Recovery	94		%	
200073833	300175338	2BN-1	Pu-238	0.1678	0.0076	pCi/g	
			Pu-239	0.9813	0.0306	pCi/g	
			Pu-242T Recovery	76.14		%	
200073834	300175343	2BN-2	Pu-238	0.0280	0.0030	pCi/g	
			Pu-239	0.0478	0.0039	pCi/g	
			Pu-242T Recovery	62.22		%	
200073835	300175348	2BN-3	Pu-238	0.2507	0.0125	pCi/g	
			Pu-239	0.0576	0.0050	pCi/g	
			Pu-242T Recovery	48.55		%	

**** FINAL REPORT ****

Method: PU RAS ENV **Method Area: EH-ALPHA** **Submission Id : 100032167**

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073836	300175353	3ABN-1	Pu-238	0.0079	0.0028	pCi/g	
			Pu-239	0.0107	0.0033	pCi/g	
			Pu-242T Recovery	22.34		%	
200073837	300175358	3ABN-2	Pu-238	0.0056	0.0015	pCi/g	
			Pu-239	0.0079	0.0019	pCi/g	
			Pu-242T Recovery	56.78		%	
200073838	300175363	3ABN-3	Pu-238	0.0011	0.0014	pCi/g	
			Pu-239	0.0035	0.0015	pCi/g	
			Pu-242T Recovery	38.23		%	
200073839	300175366	3BBN-1	Pu-238	0.0051	0.0019	pCi/g	
			Pu-239	0.0038	0.0022	pCi/g	
			Pu-242T Recovery	33.01		%	
200073840	300175373	3BBN-2	Pu-238	0.0098	0.0022	pCi/g	
			Pu-239	0.0011	0.0011	pCi/g	
			Pu-242T Recovery	38.23		%	
200073841	300175378	3BBN-3	Pu-238	0.0035	0.0012	pCi/g	
			Pu-239	0.0063	0.0015	pCi/g	
			Pu-242T Recovery	49.20		%	
200073842	300175383	JSAM	Pu-238	0.0012	0.0007	pCi/g	
			Pu-239	0.0073	0.0012	pCi/g	
			Pu-242T Recovery	92.39		%	
200073843	300175388	JSBN	Pu-238	0.0014	0.0006	pCi/g	
			Pu-239	0.0201	0.0023	pCi/g	
			Pu-242T Recovery	75.46		%	
200073844	300175393	CAM	Pu-238	0.0002	0.0003	pCi/g	
			Pu-239	0.0044	0.0008	pCi/g	
			Pu-242T Recovery	93.98		%	
200073845	300175398	CBN	Pu-238	0.0006	0.0004	pCi/g	
			Pu-239	0.0077	0.0012	pCi/g	
			Pu-242T Recovery	92.69		%	
200073846	300175403	GSN	Pu-238	0.0022	0.0008	pCi/g	

****** FINAL REPORT ******

Method: PU RAS ENV **Method Area: EH-ALPHA** **Submission Id : 100032167**

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073846	300175403	GSN	Pu-239	0.0050	0.0011	pCi/g	
			Pu-242T Recovery	66.60		%	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200073838	300175363		Pu-238	0.0011	0.0014	pCi/g	
			Pu-239	0.0035	0.0015	pCi/g	
		300175323	Pu-242T Recovery	38.23		%	
200084709	300194839	~~300175363~~	Pu-238	0.1966	0.0080	pCi/g	
73830		1/8/99	Pu-239	0.5567	0.0178	pCi/g	
			Pu-242T Recovery	92.61		%	
200073830	300175323		Pu-238	0.1602	0.0066	pCi/g	
			Pu-239	0.5289	0.0164	pCi/g	
		300175363	Pu-242T Recovery	98.64		%	
200084710	300194840	~~300175323~~	Pu-238	0.0043	0.0009	pCi/g	
73838		JC	Pu-239	0.0091	0.0013	pCi/g	
		1/8/99	Pu-242T Recovery	92.51		%	

****** FINAL REPORT ******

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100032167

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073847	300175406	Pu-238	0.4959	0.0155	pCi/g	0.52	0.02	pCi/g	IN CONTROL
		Pu-239	0.8094	0.0235	pCi/g	0.81	0.03	pCi/g	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300194841	Pu-238	0.0009	0.0007	pCi/g	0.0	0.0	pCi/g	IN CONTROL
		Pu-239	0.0003	0.0005	pCi/g	0.0	0.0	pCi/g	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: PU RAS ENV **Method Area:** EH-ALPHA **Submission Id :** 100033332

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	08-JAN-99
Requester Group:	ESH-20	**Logged Date:**	28-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	667-6630			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078597	300184407	V 1A-1	Pu-238	0.0368	0.0035	pCi/g	
			Pu-239	0.3109	0.0146	pCi/g	
			Pu-242T Recovery	73.48		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	37.06		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	141.		counts	
			Pu-238 Background Counts	6.2		counts	
			Pu-239 Gross Counts	1149.		counts	
			Pu-239 Background Counts	10.2		counts	
200078617	300184410	V 1A-2	Pu-238	0.0336	0.0038	pCi/g	
			Pu-239	0.0873	0.0072	pCi/g	
			Pu-242T Recovery	56.42		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	

****** FINAL REPORT ******

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078617	300184410	V 1A-2	Efficiency	36.86		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	102.		counts	
			Pu-238 Background Counts	8.8		counts	
			Pu-239 Gross Counts	255.		counts	
			Pu-239 Background Counts	13.2		counts	
200078618	300184413	V 1A-3	Pu-238	0.0505	0.0049	pCi/g	
			Pu-239	0.0630	0.0060	pCi/g	
			Pu-242T Recovery	52.07		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	37.82		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	139.		counts	
			Pu-238 Background Counts	6.4		counts	
			Pu-239 Gross Counts	173.		counts	
			Pu-239 Background Counts	7.8		counts	
200078619	300184416	V 1B-1	Pu-238	0.1666	0.0101	pCi/g	
			Pu-239	0.8649	0.0377	pCi/g	
			Pu-242T Recovery	42.56		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	41.07		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	394.		counts	
			Pu-238 Background Counts	6.2		counts	
			Pu-239 Gross Counts	2019.		counts	
			Pu-239 Background Counts	5.4		counts	
200078620	300184418	V 1B-2	Pu-238	0.2190	0.0092	pCi/g	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078620	300184418	V 1B-2	Pu-239	0.0573	0.0043	pCi/g	
			Pu-242T Recovery	91.88		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	40.65		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	1096.		counts	
			Pu-238 Background Counts	6.6		counts	
			Pu-239 Gross Counts	299.		counts	
			Pu-239 Background Counts	14.0		counts	
200078621	300184422	V 1B-3	Pu-238	0.0606	0.0042	pCi/g	
			Pu-239	0.0761	0.0054	pCi/g	
			Pu-242T Recovery	103.92		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	34.45		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	311.		counts	
			Pu-238 Background Counts	22.0		counts	
			Pu-239 Gross Counts	395.		counts	
			Pu-239 Background Counts	32.2		counts	
200078622	300184425	V 2-1	Pu-238	0.0155	0.0042	pCi/g	
			Pu-239	0.1327	0.0114	pCi/g	
			Pu-242T Recovery	35.88		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.82		%	
			Pu-242T Spike	2.05		pCi	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078622	300184425	V 2-1	Pu-238 Gross Counts	36.		counts	
			Pu-238 Background Counts	9.4		counts	
			Pu-239 Gross Counts	235.		counts	
			Pu-239 Background Counts	7.8		counts	
200078623	300184428	V 2-2	Pu-238	0.0137	0.0029	pCi/g	
			Pu-239	0.0503	0.0061	pCi/g	
			Pu-242T Recovery	50.02		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	34.51		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	40.		counts	
			Pu-238 Background Counts	8.6		counts	
			Pu-239 Gross Counts	129.		counts	
			Pu-239 Background Counts	13.4		counts	
200078624	300184431	V 2-3	Pu-238	0.0779	0.0074	pCi/g	
			Pu-239	0.0470	0.0065	pCi/g	
			Pu-242T Recovery	38.54		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.29		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	148.		counts	
			Pu-238 Background Counts	6.8		counts	
			Pu-239 Gross Counts	94.		counts	
			Pu-239 Background Counts	8.8		counts	
200078625	300184434	V 3A-1	Pu-238	0.0001	0.0016	pCi/g	
			Pu-239	0.0055	0.0022	pCi/g	
			Pu-242T Recovery	58.32		%	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078625	300184434	V 3A-1	Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.96		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	13.		counts	
			Pu-238 Background Counts	12.6		counts	
			Pu-239 Gross Counts	27.		counts	
			Pu-239 Background Counts	11.6		counts	
200078626	300184437	V 3A-2	Pu-238	0.0019	0.0022	pCi/g	
			Pu-239	0.0060	0.0028	pCi/g	
			Pu-242T Recovery	60.41		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.01		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	20.		counts	
			Pu-238 Background Counts	14.4		counts	
			Pu-239 Gross Counts	29.		counts	
			Pu-239 Background Counts	11.6		counts	
200078627	300184440	V 3A-3	Pu-238	0.0016	0.0024	pCi/g	
			Pu-239	0.0099	0.0035	pCi/g	
			Pu-242T Recovery	59.60		%	
			Analysis Date	02/04/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.95		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	19.		counts	
			Pu-238 Background Counts	14.4		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078627	300184440	V 3A-3	Pu-239 Gross Counts	44.		counts	
			Pu-239 Background Counts	15.0		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200078631	300200813	Pu-238	8.1405	0.2500	pCi/g	8.53	0.30	pCi/g	IN CONTROL
		Pu-239	8.3793	0.2854	pCi/g	8.59	0.27	pCi/g	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.39798	300200264	Pu-238	4094	142	pCi/L	4180	418	pCi/L	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22784	300200263	Pu-238	-0.0004	0.0024	pCi/g	0	0	pCi/g	IN CONTROL
		Pu-239	0.0006	0.0053	pCi/g	0	0	pCi/g	IN CONTROL

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033332

Analyst	Review	Team Leader	QA Officer
2/17/99	2/19/99	2/19/99	2/22/99
Date	Date	Date	Date

The control status of the preceeding data was evaluated using the standard statistical criteria set forth in Quality Assurance for Health and Environmental Chemistry: 1992, LA-12790-MS, Vol I, pp. 19-29.

"The reported uncertainties are at the 1 sigma confidence level unless otherwise stated."

****** FINAL REPORT ******

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-DEC-98
Requester Group:	ESH-20	**Logged Date:**	16-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6091			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077557	300182449	P-1A	Pu-238	0.3600	0.0152	pCi/g	
			Pu-239	0.4239	0.0191	pCi/g	
			Pu-242T Recovery	87.27		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	31.71		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	1175.		counts	
			Pu-238 Background Counts	7.0		counts	
			Pu-239 Gross Counts	1384.		counts	
			Pu-239 Background Counts	8.8		counts	
200077562	300182454	P-1B	Pu-238	0.4191	0.0199	pCi/g	
			Pu-239	0.3365	0.0187	pCi/g	
			Pu-242T Recovery	56.42		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077562	300182454	P-1B	Efficiency	28.88		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	923.		counts	
			Pu-238 Background Counts	13.4		counts	
			Pu-239 Gross Counts	743.		counts	
			Pu-239 Background Counts	12.6		counts	
200077563	300182459	P-2	Pu-238	0.0266	0.0049	pCi/g	
			Pu-239	0.0339	0.0058	pCi/g	
			Pu-242T Recovery	59.40		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	29.96		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	53.		counts	
			Pu-238 Background Counts	10.2		counts	
			Pu-239 Gross Counts	61.		counts	
			Pu-239 Background Counts	6.4		counts	
200077564	300182464	P-3A	Pu-238	0.0064	0.0028	pCi/g	
			Pu-239	0.0061	0.0027	pCi/g	
			Pu-242T Recovery	47.89		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.49		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	17.		counts	
			Pu-238 Background Counts	4.6		counts	
			Pu-239 Gross Counts	17.		counts	
			Pu-239 Background Counts	5.2		counts	
200077565	300182469	P-3B	Pu-238	0.0014	0.0030	pCi/g	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077565	300182469	P-3B	Pu-239	0.0096	0.0035	pCi/g	
			Pu-242T Recovery	52.36		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	33.36		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	8.		counts	
			Pu-238 Background Counts	6.0		counts	
			Pu-239 Gross Counts	20.		counts	
			Pu-239 Background Counts	6.0		counts	
200077566	300182474	P-COMB1	Pu-238	0.0009	0.0021	pCi/g	
			Pu-239	0.0053	0.0026	pCi/g	
			Pu-242T Recovery	80.55		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.24		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	8.		counts	
			Pu-238 Background Counts	6.2		counts	
			Pu-239 Gross Counts	18.		counts	
			Pu-239 Background Counts	7.6		counts	
200077567	300182479	P-COMB2	Pu-238	-0.0020	0.0014	pCi/g	
			Pu-239	0.0108	0.0030	pCi/g	
			Pu-242T Recovery	58.67		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.80		%	
			Pu-242T Spike	2.05		pCi	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077567	300182479	P-COMB2	Pu-238 Gross Counts	4.		counts	
			Pu-238 Background Counts	8.8		counts	
			Pu-239 Gross Counts	33.		counts	
			Pu-239 Background Counts	7.0		counts	
200077568	300182484	C-1A-1	Pu-238	0.0994	0.0058	pCi/g	
			Pu-239	0.0544	0.0045	pCi/g	
			Pu-242T Recovery	100.85		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.95		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	420.		counts	
			Pu-238 Background Counts	6.6		counts	
			Pu-239 Gross Counts	234.		counts	
			Pu-239 Background Counts	8.0		counts	
200077569	300182489	C-1A-2	Pu-238	0.0467	0.0043	pCi/g	
			Pu-239	0.0543	0.0051	pCi/g	
			Pu-242T Recovery	75.51		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.40		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	149.		counts	
			Pu-238 Background Counts	5.6		counts	
			Pu-239 Gross Counts	173.		counts	
			Pu-239 Background Counts	6.2		counts	
200077570	300182494	C-1A-3	Pu-238	0.0506	0.0048	pCi/g	
			Pu-239	0.0705	0.0064	pCi/g	
			Pu-242T Recovery	64.27		%	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077570	300182494	C-1A-3	Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	30.41		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	139.		counts	
			Pu-238 Background Counts	6.0		counts	
			Pu-239 Gross Counts	191.		counts	
			Pu-239 Background Counts	5.6		counts	
200077571	300182499	C-1A-4	Pu-238	0.0380	0.0039	pCi/g	
			Pu-239	0.0643	0.0056	pCi/g	
			Pu-242T Recovery	86.01		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	27.81		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	127.		counts	
			Pu-238 Background Counts	5.8		counts	
			Pu-239 Gross Counts	211.		counts	
			Pu-239 Background Counts	6.0		counts	
200077572	300182504	C-1B-1	Pu-238	0.0414	0.0049	pCi/g	
			Pu-239	0.0631	0.0069	pCi/g	
			Pu-242T Recovery	46.87		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	32.82		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	90.		counts	
			Pu-238 Background Counts	5.2		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077572	300182504	C-1B-1	Pu-239 Gross Counts	136.		counts	
			Pu-239 Background Counts	6.6		counts	
200077573	300182509	C-1B-2	Pu-238	0.1158	0.0057	pCi/g	
			Pu-239	0.8581	0.0305	pCi/g	
			Pu-242T Recovery	98.44		%	
			Analysis Date	02/10/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	41.07		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	633.		counts	
			Pu-238 Background Counts	6.2		counts	
			Pu-239 Gross Counts	4649.		counts	
			Pu-239 Background Counts	5.4		counts	
200077574	300182514	C-1B-3	Pu-238	0.0457	0.0054	pCi/g	
			Pu-239	0.1420	0.0109	pCi/g	
			Pu-242T Recovery	46.97		%	
			Analysis Date	01/22/99		MM/DD/YY	
			Instrument	32 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	31.36		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	94.		counts	
			Pu-238 Background Counts	4.4		counts	
			Pu-239 Gross Counts	284.		counts	
			Pu-239 Background Counts	5.4		counts	
200077575	300182519	C-1B-4	Pu-238	0.0662	0.0041	pCi/g	
			Pu-239	0.2929	0.0125	pCi/g	
			Pu-242T Recovery	103.36		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077575	300182519	C-1B-4	Count Time	3000.00		min	
			Efficiency	37.82		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	351.		counts	
			Pu-238 Background Counts	6.2		counts	
			Pu-239 Gross Counts	1532.		counts	
			Pu-239 Background Counts	6.8		counts	
200077576	300182523	C-2-1	Pu-238	0.0120	0.0023	pCi/g	
			Pu-239	0.1088	0.0077	pCi/g	
			Pu-242T Recovery	55.69		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	41.07		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	42.		counts	
			Pu-238 Background Counts	5.4		counts	
			Pu-239 Gross Counts	339.		counts	
			Pu-239 Background Counts	5.8		counts	
200077577	300182529	C-2-2	Pu-238	0.0590	0.0039	pCi/g	
			Pu-239	0.5767	0.0218	pCi/g	
			Pu-242T Recovery	94.35		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	40.65		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	307.		counts	
			Pu-238 Background Counts	5.8		counts	
			Pu-239 Gross Counts	2959.		counts	
			Pu-239 Background Counts	13.0		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077578	300182534	C-2-3	Pu-238	0.0056	0.0025	pCi/g	
			Pu-239	0.1484	0.0097	pCi/g	
			Pu-242T Recovery	65.88		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	34.45		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	40.		counts	
			Pu-238 Background Counts	23.2		counts	
			Pu-239 Gross Counts	481.		counts	
			Pu-239 Background Counts	32.4		counts	
200077579	300182539	C-2-4	Pu-238	0.0071	0.0025	pCi/g	
			Pu-239	0.0843	0.0072	pCi/g	
			Pu-242T Recovery	57.35		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.82		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	28.		counts	
			Pu-238 Background Counts	8.6		counts	
			Pu-239 Gross Counts	240.		counts	
			Pu-239 Background Counts	9.4		counts	
200077580	300182544	C-3A-1	Pu-238	0.0035	0.0011	pCi/g	
			Pu-239	0.0779	0.0053	pCi/g	
			Pu-242T Recovery	102.15		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	34.51		%	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077580	300182544	C-3A-1	Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	25.		counts	
			Pu-238 Background Counts	8.6		counts	
			Pu-239 Gross Counts	377.		counts	
			Pu-239 Background Counts	11.4		counts	
200077581	300182548	C-3A-2	Pu-238	0.0071	0.0015	pCi/g	
			Pu-239	0.1136	0.0065	pCi/g	
			Pu-242T Recovery	104.92		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.29		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	41.		counts	
			Pu-238 Background Counts	5.8		counts	
			Pu-239 Gross Counts	569.		counts	
			Pu-239 Background Counts	8.6		counts	
200077582	300182554	C-3A-3	Pu-238	0.0168	0.0025	pCi/g	
			Pu-239	0.2119	0.0111	pCi/g	
			Pu-242T Recovery	73.86		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.96		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	73.		counts	
			Pu-238 Background Counts	12.4		counts	
			Pu-239 Gross Counts	777.		counts	
			Pu-239 Background Counts	12.4		counts	
200077583	300182559	C-3A-4	Pu-238	0.0075	0.0017	pCi/g	
			Pu-239	0.0622	0.0046	pCi/g	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077583	300182559	C-3A-4	Pu-242T Recovery	101.73		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.01		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	50.		counts	
			Pu-238 Background Counts	13.2		counts	
			Pu-239 Gross Counts	314.		counts	
			Pu-239 Background Counts	10.4		counts	
200077584	300182562	C-3B-1	Pu-238	0.0070	0.0016	pCi/g	
			Pu-239	0.0880	0.0059	pCi/g	
			Pu-242T Recovery	92.30		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.95		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	43.		counts	
			Pu-238 Background Counts	11.2		counts	
			Pu-239 Gross Counts	416.		counts	
			Pu-239 Background Counts	14.4		counts	
200077585	300182569	C-3B-2	Pu-238	0.0004	0.0013	pCi/g	
			Pu-239	0.0105	0.0023	pCi/g	
			Pu-242T Recovery	79.33		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.40		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	11.		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077585	300182569	C-3B-2	Pu-238 Background Counts	9.4		counts	
			Pu-239 Gross Counts	50.		counts	
			Pu-239 Background Counts	10.6		counts	
200077586	300182574	C-3B-3	Pu-238	0.0004	0.0009	pCi/g	
			Pu-239	0.0091	0.0025	pCi/g	
			Pu-242T Recovery	84.46		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.58		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	10.		counts	
			Pu-238 Background Counts	8.2		counts	
			Pu-239 Gross Counts	50.		counts	
			Pu-239 Background Counts	11.8		counts	
200077587	300182579	C-CS	Pu-238	0.0066	0.0017	pCi/g	
			Pu-239	0.0523	0.0047	pCi/g	
			Pu-242T Recovery	74.21		%	
			Analysis Date	01/28/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	38.83		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	33.		counts	
			Pu-238 Background Counts	7.4		counts	
			Pu-239 Gross Counts	213.		counts	
			Pu-239 Background Counts	10.4		counts	
200077588	300182584	C-GS	Pu-238	0.0013	0.0016	pCi/g	
			Pu-239	0.0116	0.0024	pCi/g	
			Pu-242T Recovery	74.09		%	
			Analysis Date	01/28/99		MM/DD/YY	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077588	300182584	C-GS	Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.82		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	22.		counts	
			Pu-238 Background Counts	17.2		counts	
			Pu-239 Gross Counts	54.		counts	
			Pu-239 Background Counts	11.8		counts	
200077589	300182589	C-JS	Pu-238	0.0009	0.0019	pCi/g	
			Pu-239	0.0131	0.0037	pCi/g	
			Pu-242T Recovery	39.82		%	
			Analysis Date	02/10/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	37.06		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	8.		counts	
			Pu-238 Background Counts	6.2		counts	
			Pu-239 Gross Counts	36.		counts	
			Pu-239 Background Counts	10.2		counts	
200077590	300182594	C-COMB	Pu-238	0.0066	0.0019	pCi/g	
			Pu-239	0.0449	0.0049	pCi/g	
			Pu-242T Recovery	61.48		%	
			Analysis Date	02/10/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.86		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	29.		counts	
			Pu-238 Background Counts	8.8		counts	
			Pu-239 Gross Counts	150.		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077590	300182594	C-COMB	Pu-239 Background Counts	13.2		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200077594	300182596	Pu-238	5.3095	0.1680	pCi/g	5.80	0.20	pCi/g	IN CONTROL
		Pu-239	6.6425	0.2308	pCi/g	6.98	0.22	pCi/g	IN CONTROL
200077595	300182600	Pu-238	6.9374	0.2251	pCi/g	7.20	0.25	pCi/g	IN CONTROL
		Pu-239	7.6838	0.2755	pCi/g	7.91	0.25	pCi/g	IN CONTROL
200077596	300182598	Pu-238	6.2773	0.2038	pCi/g	6.51	0.23	pCi/g	IN CONTROL
		Pu-239	4.7142	0.1727	pCi/g	4.67	0.15	pCi/g	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.39798	300200677	Pu-238	3987	1324	pCi/L	4180	418	pCi/L	IN CONTROL

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033001

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22784	300200674	Pu-238	0.0015	0.0042	pCi/g	0	0	pCi/g	IN CONTROL
		Pu-239	0.0031	0.0042	pCi/g	0	0	pCi/g	IN CONTROL
00.22784	300200675	Pu-238	-0.0008	0.0021	pCi/g	0	0	pCi/g	IN CONTROL
		Pu-239	-0.0006	0.0026	pCi/g	0	0	pCi/g	IN CONTROL
00.22784	300200676	Pu-238	0.0002	0.0018	pCi/g	0	0	pCi/g	IN CONTROL
		Pu-239	0.0038	0.0035	pCi/g	0	0	pCi/g	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033343

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	08-JAN-99
Requester Group:	ESH-20	**Logged Date:**	28-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	667-0815			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078652	300184490	V 3B-1	Pu-238	0.0049	0.0014	pCi/g	
			Pu-239	0.0097	0.0024	pCi/g	
			Pu-242T Recovery	73.70		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	37.06		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	23.		counts	
			Pu-238 Background Counts	5.0		counts	
			Pu-239 Gross Counts	45.		counts	
			Pu-239 Background Counts	9.6		counts	
200078659	300184493	V 3B-2	Pu-238	0.0030	0.0014	pCi/g	
			Pu-239	0.0080	0.0024	pCi/g	
			Pu-242T Recovery	71.54		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033343

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078659	300184493	V 3B-2	Efficiency	36.86		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	20.		counts	
			Pu-238 Background Counts	9.4		counts	
			Pu 239 Gross Counts	39.		counts	
			Pu-239 Background Counts	10.8		counts	
200078660	300184496	V 3B-3	Pu-238	0.0040	0.0017	pCi/g	
			Pu-239	0.0070	0.0019	pCi/g	
			Pu-242T Recovery	62.69		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	37.82		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	18.		counts	
			Pu-238 Background Counts	5.4		counts	
			Pu-239 Gross Counts	29.		counts	
			Pu-239 Background Counts	6.8		counts	
200078661	300184499	V CV-1	Pu-238	0.0016	0.0009	pCi/g	
			Pu-239	0.0039	0.0012	pCi/g	
			Pu-242T Recovery	92.72		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	41.07		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	13.		counts	
			Pu-238 Background Counts	4.8		counts	
			Pu-239 Gross Counts	26.		counts	
			Pu-239 Background Counts	6.0		counts	
200078662	300184501	V CV-2	Pu-238	0.0013	0.0008	pCi/g	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033343

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078662	300184501	V CV-2	Pu-239	0.0055	0.0016	pCi/g	
			Pu-242T Recovery	92.69		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	40.65		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	13.		counts	
			Pu-238 Background Counts	6.6		counts	
			Pu-239 Gross Counts	42.		counts	
			Pu-239 Background Counts	14.6		counts	
200078663	300184505	V CV-3	Pu-238	-0.0014	0.0011	pCi/g	
			Pu-239	-0.0029	0.0012	pCi/g	
			Pu-242T Recovery	98.75		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	34.45		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	14.		counts	
			Pu-238 Background Counts	20.2		counts	
			Pu-239 Gross Counts	17.		counts	
			Pu-239 Background Counts	30.2		counts	
200078664	300184508	V GS-1	Pu-238	0.0031	0.0021	pCi/g	
			Pu-239	0.0033	0.0024	pCi/g	
			Pu-242T Recovery	55.17		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.82		%	
			Pu-242T Spike	2.05		pCi	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033343

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078664	300184508	V GS-1	Pu-238 Gross Counts	15.		counts	
			Pu-238 Background Counts	7.8		counts	
			Pu-239 Gross Counts	16.		counts	
			Pu-239 Background Counts	8.2		counts	
200078665	300184511	V GS-2	Pu-238	0.0034	0.0011	pCi/g	
			Pu-239	0.0073	0.0020	pCi/g	
			Pu-242T Recovery	99.50		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	34.51		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	23.		counts	
			Pu-238 Background Counts	7.6		counts	
			Pu-239 Gross Counts	47.		counts	
			Pu-239 Background Counts	13.8		counts	
200078666	300184514	V GS-3	Pu-238	0.0006	0.0008	pCi/g	
			Pu-239	0.0048	0.0016	pCi/g	
			Pu-242T Recovery	94.63		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.29		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	7.		counts	
			Pu-238 Background Counts	4.4		counts	
			Pu-239 Gross Counts	30.		counts	
			Pu-239 Background Counts	8.6		counts	
200078667	300184517	V JS-1	Pu-238	0.0021	0.0011	pCi/g	
			Pu-239	0.0213	0.0027	pCi/g	
			Pu-242T Recovery	93.32		%	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033343

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078667	300184517	V JS-1	Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	35.96		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	22.		counts	
			Pu-238 Background Counts	12.6		counts	
			Pu-239 Gross Counts	108.		counts	
			Pu-239 Background Counts	12.8		counts	
200078668	300184520	V JS-2	Pu-238	0.0005	0.0015	pCi/g	
			Pu-239	0.0047	0.0022	pCi/g	
			Pu-242T Recovery	87.77		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.01		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	16.		counts	
			Pu-238 Background Counts	14.0		counts	
			Pu-239 Gross Counts	34.		counts	
			Pu-239 Background Counts	14.2		counts	
200078669	300184523	V JS-3	Pu-238	0.0007	0.0026	pCi/g	
			Pu-239	0.0062	0.0025	pCi/g	
			Pu-242T Recovery	54.83		%	
			Analysis Date	02/25/99		MM/DD/YY	
			Instrument	96 ALPHA		NONE	
			Count Time	3000.00		min	
			Efficiency	36.95		%	
			Pu-242T Spike	2.05		pCi	
			Pu-238 Gross Counts	16.		counts	
			Pu-238 Background Counts	14.2		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033343

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078669	300184523	V JS-3	Pu-239 Gross Counts	31.		counts	
			Pu-239 Background Counts	14.4		counts	

**** FINAL REPORT ****

Method: PU RAS ENV Method Area: EH-ALPHA Submission Id : 100033343

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200078682	300184525	Pu-238	7.5323	0.2515	pCi/g	7.88	0.28	pCi/g	IN CONTROL
		Pu-239	3.2010	0.1260	pCi/g	3.23	0.10	pCi/g	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.39798	300203047	Pu-238	4200	130	pCi/L	4180	418	pCi/L	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22784	300203046	Pu-238	0.0036	0.0035	pCi/g	0	0	pCi/g	IN CONTROL
		Pu-239	0.0047	0.0041	pCi/g	0	0	pCi/g	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV **Method Area:** EH-ALPHA **Submission Id :** 100032162

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175210	1AAM-1	H-3	85600	3700	pCi/L	
			H-3 MDA	500		pCi/L	
200073784	300175214	1AAM-2	H-3	242000	8000	pCi/L	
			H-3 MDA	500		pCi/L	
200073785	300175218	1AAM-3	H-3	30300	2000	pCi/L	
			H-3 MDA	500		pCi/L	
200073786	300175219	1BAM-1	H-3	7800	1100	pCi/L	
			H-3 MDA	500		pCi/L	
200073787	300175226	1BAM-2	H-3	7900	1100	pCi/L	
			H-3 MDA	500		pCi/L	
200073788	300175230	1BAM-3	H-3	5500	1000	pCi/L	
			H-3 MDA	500		pCi/L	
200073789	300175234	2AM-1	H-3	11900	1300	pCi/L	
			H-3 MDA	500		pCi/L	
200073790	300175237	2AM-2	H-3	4950	980	pCi/L	
			H-3 MDA	460		pCi/L	
200073791	300175242	2AM-3	H-3	2160	830	pCi/L	
			H-3 MDA	420		pCi/L	

****** FINAL REPORT ******

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100032162

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073792	300175246	3AAM-1	H-3	10000	1200	pCi/L	
			H-3 MDA	500		pCi/L	
200073793	300175250	3AAM-2	H-3	1200000	34000	pCi/L	
			H-3 MDA	500		pCi/L	
200073794	300175254	3AAM-3	H-3	880000	25000	pCi/L	
			H-3 MDA	500		pCi/L	
200073795	300175258	3BAM-1	H-3	186300000	5000000	pCi/L	
			H-3 MDA	500		pCi/L	
200073796	300175262	3BAM-2	H-3	4040000	110000	pCi/L	
			H-3 MDA	500		pCi/L	
200073797	300175266	3BAM-3	H-3	251900	8300	pCi/L	
			H-3 MDA	500		pCi/L	
200073798	300175270	1ABN-1	H-3	18000	1500	pCi/L	
			H-3 MDA	500		pCi/L	
200073799	300175274	1ABN-2	H-3	75200	3400	pCi/L	
			H-3 MDA	500		pCi/L	
200073800	300175278	1ABN-3	H-3	647000	19000	pCi/L	
			H-3 MDA	500		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100032162

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073801	300175279	H-3	6000	1000	pCi/L	6890	179	pCi/L	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38287	300177377	H-3	0.00018	0.00071	uCi/L	0	0	uCi/L	IN CONTROL
00.39929	300177378	H-3	0.0134	0.0014	uCi/L	0.01427	0.00143	uCi/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV **Method Area:** EH-ALPHA **Submission Id :** 100032167

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073830	300175321	1BBN-1	H-3	2320	790	pCi/L	
			H-3 MDA	450		pCi/L	
200073831	300175326	1BBN-2	H-3	3630	870	pCi/L	
			H-3 MDA	450		pCi/L	
200073832	300175331	1BBN-3	H-3	137700	5200	pCi/L	
			H-3 MDA	400		pCi/L	
200073833	300175336	2BN-1	H-3	6600	1000	pCi/L	
			H-3 MDA	400		pCi/L	
200073834	300175341	2BN-2	H-3	2490	800	pCi/L	
			H-3 MDA	440		pCi/L	
200073835	300175346	2BN-3	H-3	2610	810	pCi/L	
			H-3 MDA	450		pCi/L	
200073836	300175351	3ABN-1	H-3	85000000	2300000	pCi/L	
			H-3 MDA	450		pCi/L	
200073837	300175356	3ABN-2	H-3	606000	18000	pCi/L	
			H-3 MDA	450		pCi/L	
200073838	300175361	3ABN-3	H-3	68300	3200	pCi/L	
			H-3 MDA	400		pCi/L	

****** FINAL REPORT ******

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100032167

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073839	300175369	3BBN-1	H-3	272000	8900	pCi/L	
			H-3 MDA	500		pCi/L	
200073840	300175371	3BBN-2	H-3	634000	19000	pCi/L	
			H-3 MDA	450		pCi/L	
200073841	300175376	3BBN-3	H-3	6610000	180000	pCi/L	
			H-3 MDA	450		pCi/L	
200073842	300175381	JSAM	H-3	400	670	pCi/L	
			H-3 MDA	450		pCi/L	
200073843	300175386	JSBN	H-3	350	670	pCi/L	
			H-3 MDA	450		pCi/L	
200073844	300175391	CAM	H-3	410	670	pCi/L	
			H-3 MDA	430		pCi/L	
200073845	300175396	CBN	H-3	430	670	pCi/L	
			H-3 MDA	450		pCi/L	
200073846	300175401	GSN	H-3	260	660	pCi/L	
			H-3 MDA	450		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100032167

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073849	300175409	H-3	1130	720	pCi/L	920	24	pCi/L	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38287	300177381	H-3	0.00003	0.00065	uCi/L	0	0	uCi/L	IN CONTROL
00.39929	300177382	H-3	0.0132	0.0013	uCi/L	0.01427	0.00143	uCi/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV **Method Area:** EH-ALPHA **Submission Id :** 100033135

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A0201SA00	**Due Date:**	23-DEC-98
Requester Group:	ESH-20	**Logged Date:**	20-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	LPRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077849	300182894	GSAM	H-3	-460	620	pCi/L	
			H-3 MDA	480		pCi/L	

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****** FINAL REPORT ******

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033134

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	23-DEC-98
Requester Group:	ESH-20	**Logged Date:**	20-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077848	300182897	P 1A-1	H-3	803000	23000	pCi/L	
			H-3 MDA	1000		pCi/L	
200077850	300182898	P 1A-2	H-3	25600	1800	pCi/L	
			H-3 MDA	500		pCi/L	
200077851	300182899	P 1A-3	H-3	1457000	41000	pCi/L	
			H-3 MDA	500		pCi/L	
200077852	300182900	P 1A-4	H-3	30300	2000	pCi/L	
			H-3 MDA	600		pCi/L	
200077853	300182901	C 1B-1	H-3	27000	1800	pCi/L	
			H-3 MDA	500		pCi/L	
200077854	300182902	C 1B-2	H-3	276300	9000	pCi/L	
			H-3 MDA	500		pCi/L	
200077855	300182903	C 1B-3	H-3	39400	2300	pCi/L	
			H-3 MDA	500		pCi/L	
200077856	300182904	C 1B-4	H-3	96100	4000	pCi/L	
			H-3 MDA	500		pCi/L	
200077857	300182905	P 1B-1	H-3	27000	1800	pCi/L	
			H-3 MDA	500		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033134

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077858	300182906	P 1B-2	H-3	256400	8400	pCi/L	
			H-3 MDA	500		pCi/L	
200077859	300182907	P 3A-1	H-3	420000	13000	pCi/L	
			H-3 MDA	500		pCi/L	
200077860	300182908	P 3A-2	H-3	572000	17000	pCi/L	
			H-3 MDA	500		pCi/L	
200077861	300182909	P 3A-3	H-3	2168000	60000	pCi/L	
			H-3 MDA	500		pCi/L	
200077862	300182910	P 3A-4	H-3	102100	4100	pCi/L	
			H-3 MDA	500		pCi/L	
200077863	300182911	C 3B-1	H-3	236600000	6400000	pCi/L	
			H-3 MDA	500		pCi/L	
200077864	300182912	C 3B-2	H-3	1357000	38000	pCi/L	
			H-3 MDA	500		pCi/L	
200077865	300182913	C 3B-3	H-3	121200000	3300000	pCi/L	
			H-3 MDA	500		pCi/L	
200077866	300182914	P 3B-1	H-3	235700000	6300000	pCi/L	
			H-3 MDA	500		pCi/L	

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DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200077858	300182906		H-3	256400	8400	pCi/L	
			H-3 MDA	500		pCi/L	
200079789	300186493	300182906	H-3	243600	8100	pCi/L	
			H-3 MDA	500		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033134

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200077867	300182915	H-3	15600	1400	pCi/L	16200	600	pCi/L	IN CONTROL
200077868	300182916	H-3	16300	1400	pCi/L	17900	660	pCi/L	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38286	300186491	H-3	-0.00060	0.00062	uCi/L	0	0	uCi/L	IN CONTROL
00.39930	300186492	H-3	0.0121	0.0013	uCi/L	0.01427	0.00143	uCi/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033140

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	23-DEC-98
Requester Group:	ESH-20	**Logged Date:**	20-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077878	300182976	P 3B-2	H-3	1887000	52000	pCi/L	
			H-3 MDA	500		pCi/L	
200077889	300182977	P 3B-3	H-3	114400000	3100000	pCi/L	
			H-3 MDA	500		pCi/L	
200077890	300182978	C CS	H-3	810	710	pCi/L	
			H-3 MDA	480		pCi/L	
200077891	300182979	C GS	H-3	-230	640	pCi/L	
			H-3 MDA	490		pCi/L	
200077892	300182980	C JS	H-3	-10	660	pCi/L	
			H-3 MDA	490		pCi/L	
200077893	300182981	C COMB	H-3	90	660	pCi/L	
			H-3 MDA	480		pCi/L	
200077894	300182982	P CS	H-3	4510	920	pCi/L	
			H-3 MDA	500		pCi/L	
200077895	300182983	P GS	H-3	1030	730	pCi/L	
			H-3 MDA	490		pCi/L	
200077896	300182984	P JS	H-3	1480	750	pCi/L	
			H-3 MDA	500		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033140

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077897	300182985	P COMB	H-3	950	720	pCi/L	
			H-3 MDA	490		pCi/L	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200077892	300182980		H-3	-10	660	pCi/L	
			H-3 MDA	490		pCi/L	
200079790	300186494	300182980	H-3	20	660	pCi/L	
			H-3 MDA	490		pCi/L	

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**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033140

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200077899	300182986	H-3	16500	1500	pCi/L	18800	690	pCi/L	IN CONTROL

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**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033171

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	24-DEC-98
Requester Group:	ESH-20	**Logged Date:**	21-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	AFODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077977	300183084	V 1A-1	H-3	243000	8100	pCi/L	
			H-3 MDA	500		pCi/L	
200077978	300183085	V 1A-2	H-3	1757000	49000	pCi/L	
			H-3 MDA	500		pCi/L	
200077979	300183086	V 1A-3	H-3	3308000	91000	pCi/L	
			H-3 MDA	500		pCi/L	
200077980	300183087	V 1B-1	H-3	10300	1200	pCi/L	
			H-3 MDA	500		pCi/L	
200077981	300183088	V 1B-2	H-3	39400	2300	pCi/L	
			H-3 MDA	500		pCi/L	
200077982	300183089	V 1B-3	H-3	249300	8200	pCi/L	
			H-3 MDA	500		pCi/L	
200077983	300183090	V 2-1	H-3	25900	1800	pCi/L	
			H-3 MDA	500		pCi/L	
200077984	300183091	V 2-2	H-3	17900	1500	pCi/L	
			H-3 MDA	500		pCi/L	
200077985	300183092	V 2-3	H-3	8200	1100	pCi/L	
			H-3 MDA	500		pCi/L	

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**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033171

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077986	300183093	V 3A-1	H-3	2750000000	70000000	pCi/L	
			H-3 MDA	500		pCi/L	
200077987	300183094	V 3A-2	H-3	2838000	78000	pCi/L	
			H-3 MDA	500		pCi/L	
200077988	300183095	V 3A-3	H-3	1109000	31000	pCi/L	
			H-3 MDA	500		pCi/L	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200077983	300183090		H-3	25900	1800	pCi/L	
			H-3 MDA	500		pCi/L	
200080288	300187278	300183090	H-3	25400	1800	pCi/L	
			H-3 MDA	500		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033171

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200077989	300183096	H-3	11900	1300	pCi/L	13600	500	pCi/L	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38286	300187276	H-3	-0.00044	0.00063	uCi/L	0	0	uCi/L	IN CONTROL
00.39930	300187277	H-3	0.0120	0.0013	uCi/L	0.01427	0.00143	uCi/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033172

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	24-DEC-98
Requester Group:	ESH-20	**Logged Date:**	21-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077990	300183107	V 3B-1	H-3	1393000	39000	pCi/L	
			H-3 MDA	500		pCi/L	
200077991	300183108	V 3B-2	H-3	6590000	180000	pCi/L	
			H-3 MDA	500		pCi/L	
200077992	300183109	V 3B-3	H-3	1560000000	40000000	pCi/L	
			H-3 MDA	500		pCi/L	
200077993	300183110	V CV-1	H-3	4790	940	pCi/L	
			H-3 MDA	500		pCi/L	
200077994	300183111	V CV-2	H-3	4220	910	pCi/L	
			H-3 MDA	500		pCi/L	
200077995	300183112	V CV-3	H-3	4280	910	pCi/L	
			H-3 MDA	490		pCi/L	
200077996	300183113	V GS-1	H-3	-290	640	pCi/L	
			H-3 MDA	480		pCi/L	
200077997	300183114	V GS-2	H-3	280	640	pCi/L	
			H-3 MDA	480		pCi/L	
200077998	300183115	V GS-3	H-3	120	670	pCi/L	
			H-3 MDA	470		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033172

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077999	300183116	V JS-1	H-3	2680	830	pCi/L	
			H-3 MDA	490		pCi/L	
200078000	300183117	V JS-2	H-3	-390	630	pCi/L	
			H-3 MDA	490		pCi/L	
200078001	300183118	V JS-3	H-3	-130	650	pCi/L	
			H-3 MDA	480		pCi/L	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200077996	300183113		H-3	-290	640	pCi/L	
			H-3 MDA	480		pCi/L	
200080289	300187279	300183113	H-3	-300	640	pCi/L	
			H-3 MDA	480		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033172

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200078007	300183119	H-3	17300	1500	pCi/L	19600	730	pCi/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033122

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	23-DEC-98
Requester Group:	ESH-20	**Logged Date:**	20-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	667-0815			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077794	300182811	P 1B-3	H-3	34600	2100	pCi/L	
			H-3 MDA	500		pCi/L	
200077803	300182812	P 1B-4	H-3	97900	4000	pCi/L	
			H-3 MDA	500		pCi/L	
200077804	300182813	C 2-1	H-3	4440	920	pCi/L	
			H-3 MDA	480		pCi/L	
200077805	300182814	C 2-2	H-3	8600	1100	pCi/L	
			H-3 MDA	500		pCi/L	
200077806	300182815	C 2-3	H-3	9200	1100	pCi/L	
			H-3 MDA	500		pCi/L	
200077807	300182816	C 2-4	H-3	6200	1000	pCi/L	
			H-3 MDA	500		pCi/L	
200077808	300182817	P 2-1	H-3	8300	1100	pCi/L	
			H-3 MDA	500		pCi/L	
200077809	300182818	P 2-2	H-3	7800	1100	pCi/L	
			H-3 MDA	500		pCi/L	
200077810	300182819	P 2-3	H-3	10400	1200	pCi/L	
			H-3 MDA	500		pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033122

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077811	300182820	P 2-4	H-3	6700	1000	pCi/L	
			H-3 MDA	500		pCi/L	
200077812	300182821	C 3A-1	H-3	451000	14000	pCi/L	
			H-3 MDA	500		pCi/L	
200077813	300182822	C 3A-2	H-3	594000	18000	pCi/L	
			H-3 MDA	500		pCi/L	
200077814	300182823	C 3A-3	H-3	2155000	60000	pCi/L	
			H-3 MDA	500		pCi/L	
200077815	300182824	C 3A-4	H-3	100900	4100	pCi/L	
			H-3 MDA	500		pCi/L	
200077816	300182825	C 1A-1	H-3	866000	25000	pCi/L	
			H-3 MDA	500		pCi/L	
200077817	300182826	C 1A-2	H-3	24900	1800	pCi/L	
			H-3 MDA	500		pCi/L	
200077818	300182827	C 1A-3	H-3	1558000	44000	pCi/L	
			H-3 MDA	500		pCi/L	
200077819	300182828	C 1A-4	H-3	26700	1800	pCi/L	
			H-3 MDA	500		pCi/L	
200079314	300185664	P 3B-4	H-3	39400000	1100000	pCi/L	
			H-3 MDA	500		pCi/L	
200079315	300185663	C 3B-4	H-3	47500000	1300000	pCi/L	
			H-3 MDA	500		pCi/L	

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200077812	300182821		H-3	451000	14000	pCi/L	
			H-3 MDA	500		pCi/L	
200080576	300187669	300182821	H-3	455000	14000	pCi/L	

**** FINAL REPORT ****

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033122

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200080576	300187669	300182821	H-3 MDA	500		pCi/L	

Method: H-3 LS ENV Method Area: EH-ALPHA Submission Id : 100033122

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200077825	300182829	H-3	12700	1300	pCi/L	12800	470	pCi/L	IN CONTROL
200077828	300182830	H-3	15200	1400	pCi/L	16200	600	pCi/L	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38286	300187667	H-3	-0.00069	0.00061	uCi/L	0	0	uCi/L	IN CONTROL
00.39930	300187668	H-3	0.0119	0.0013	uCi/L	0.01427	0.00143	uCi/L	IN CONTROL

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**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

T&430

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100032162

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175209	1AAM-1	U	2.62	0.26	ug/g	
200073784	300175213	1AAM-2	U	2.39	0.24	ug/g	
200073785	300175217	1AAM-3	U	1.94	0.19	ug/g	
200073786	300175222	1BAM-1	U	2.42	0.24	ug/g	
200073787	300175225	1BAM-2	U	2.71	0.27	ug/g	
200073788	300175229	1BAM-3	U	2.73	0.27	ug/g	
200073789	300175233	2AM-1	U	3.00	0.30	ug/g	
200073790	300175236	2AM-2	U	2.06	0.21	ug/g	
200073791	300175241	2AM-3	U	2.16	0.22	ug/g	
200073792	300175245	3AAM-1	U	2.00	0.20	ug/g	
200073793	300175249	3AAM-2	U	2.83	0.28	ug/g	
200073794	300175253	3AAM-3	U	2.18	0.22	ug/g	
200073795	300175257	3BAM-1	U	2.12	0.21	ug/g	
200073796	300175261	3BAM-2	U	2.68	0.27	ug/g	
200073797	300175265	3BAM-3	U	2.28	0.23	ug/g	
200073798	300175269	1ABN-1	U	4.08	0.41	ug/g	
200073799	300175273	1ABN-2	U	2.51	0.25	ug/g	
200073800	300175277	1ABN-3	U	2.34	0.23	ug/g	

**** FINAL REPORT ****

8-4-30

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100032162

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175209		U	2.62	0.26	ug/g	
200079871	300186592	300175209	U	2.56	0.26	ug/g	
200073794	300175253		U	2.18	0.22	ug/g	
200079872	300186593	300175253	U	2.23	0.22	ug/g	

**** FINAL REPORT ****

904.30

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100032162

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073802	300175281	U	0.57	0.06	ug/g	0.98	0.05	ug/g	OUT OF CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38058	300186590	U	10.39	1.04	ug/L	10.1	1.0	ug/L	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300186591	U	0.00	0.01	ug/g	0	0	ug/g	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

6CL31

Method: GENERIC KPA **Method Area:** EH-ALPHA **Submission Id :** 100032167

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LPRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073830	300175324	1BBN-1	U	2.62	0.26	ug/g	
200073831	300175329	1BBN-2	U	2.75	0.28	ug/g	
200073832	300175334	1BBN-3	U	2.45	0.25	ug/g	
200073833	300175339	2BN-1	U	27.15	2.72	ug/g	
200073834	300175344	2BN-2	U	2.39	0.24	ug/g	
200073835	300175349	2BN-3	U	2.66	0.27	ug/g	
200073836	300175354	3ABN-1	U	2.69	0.27	ug/g	
200073837	300175359	3ABN-2	U	2.71	0.27	ug/g	
200073838	300175364	3ABN-3	U	3.08	0.31	ug/g	
200073839	300175367	3BBN-1	U	2.41	0.24	ug/g	
200073840	300175374	3BBN-2	U	3.08	0.31	ug/g	
200073841	300175379	3BBN-3	U	2.73	0.27	ug/g	
200073842	300175384	JSAM	U	4.73	0.47	ug/g	
200073843	300175389	JSBN	U	4.47	0.45	ug/g	
200073844	300175394	CAM	U	2.33	0.23	ug/g	
200073845	300175399	CBN	U	2.13	0.21	ug/g	
200073846	300175404	GSN	U	3.08	0.31	ug/g	

****** FINAL REPORT ******

T&L 31

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100032167

DUPLICATE TASKS

Sample Id	Task Id	Original Task	Component	Result Value	Uncertainty	Units	Qualifier
200073830	300175324		U	2.62	0.26	ug/g	
200079890	300186611	300175324	U	2.66	0.27	ug/g	
200073838	300175364		U	3.08	0.31	ug/g	
200079891	300186612	300175364	U	3.16	0.32	ug/g	

**** FINAL REPORT ****

8/9-31

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100032167

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073848	300175408	U	1.83	0.18	ug/g	2.38	0.07	ug/g	WARNING 2-3SIG

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38058	300186609	U	10.77	1.08	ug/L	10.1	1.0	ug/L	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300186610	U	0.00	0.01	ug/g	0	0	ug/g	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

304-11

Method: GENERIC KPA **Method Area:** EH-ALPHA **Submission Id :** 100033135

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A0201SA00	**Due Date:**	23-DEC-98
Requester Group:	ESH-20	**Logged Date:**	20-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-6630			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077849	300182893	GSAM	U	3.51	0.35	ug/g	

**** FINAL REPORT ****

404-11

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100033135

********** CST QUALITY ASSURANCE REPORT **********

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38058	300187145	U	10.23	1.02	ug/L	10.1	1.0	ug/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

704 45

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100033001

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-DEC-98
Requester Group:	ESH-20	**Logged Date:**	16-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS	**Logged by:**	LBRANCH
Requester Phone:	665-6091				
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077557	300182447	P-1A	U	0.81	0.08	ug/g	
200077562	300182452	P-1B	U	0.41	0.04	ug/g	
200077563	300182457	P-2	U	1.13	0.11	ug/g	
200077564	300182462	P-3A	U	0.31	0.03	ug/g	
200077565	300182467	P-3B	U	0.79	0.08	ug/g	
200077566	300182472	P-COMB1	U	0.51	0.05	ug/g	
200077567	300182477	P-COMB2	U	0.80	0.08	ug/g	
200077568	300182482	C-1A-1	U	0.17	0.02	ug/g	
200077569	300182487	C-1A-2	U	0.14	0.01	ug/g	
200077570	300182492	C-1A-3	U	0.26	0.03	ug/g	
200077571	300182497	C-1A-4	U	0.27	0.03	ug/g	
200077572	300182502	C-1B-1	U	0.18	0.02	ug/g	
200077573	300182507	C-1B-2	U	0.30	0.03	ug/g	
200077574	300182512	C-1B-3	U	0.29	0.03	ug/g	
200077575	300182517	C-1B-4	U	0.28	0.03	ug/g	
200077576	300182521	C-2-1	U	0.33	0.03	ug/g	
200077577	300182527	C-2-2	U	0.19	0.02	ug/g	
200077578	300182532	C-2-3	U	0.45	0.05	ug/g	

**** FINAL REPORT ****

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Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100033001

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200077579	300182537	C-2-4	U	0.20	0.02	ug/g	
200077580	300182542	C-3A-1	U	0.22	0.02	ug/g	
200077581	300182546	C-3A-2	U	0.23	0.02	ug/g	
200077582	300182552	C-3A-3	U	0.20	0.02	ug/g	
200077583	300182557	C-3A-4	U	0.28	0.03	ug/g	
200077584	300182565	C-3B-1	U	0.31	0.03	ug/g	
200077585	300182567	C-3B-2	U	0.30	0.03	ug/g	
200077586	300182572	C-3B-3	U	0.25	0.03	ug/g	
200077587	300182577	C-CS	U	0.17	0.02	ug/g	
200077588	300182582	C-GS	U	1.30	0.13	ug/g	
200077589	300182587	C-JS	U	0.31	0.03	ug/g	
200077590	300182592	C-COMB	U	0.31	0.03	ug/g	

**** FINAL REPORT ****

908-45

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100033001

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200077597	300182604	U	0.41	0.04	ug/g	0.40	0.040	ug/g	IN CONTROL
200077598	300182603	U	0.38	0.04	ug/g	0.38	0.038	ug/g	IN CONTROL
200077599	300182602	U	0.26	0.03	ug/g	0.25	0.025	ug/g	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38058	300197483	U	10.32	1.03	ug/L	10.1	1.0	ug/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100033332

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	08-JAN-99
Requester Group:	ESH-20	**Logged Date:**	28-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS	**Logged by:**	APODACA
Requester Phone:	667-6630				
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078597	300184408	V 1A-1	U	0.45	0.05	ug/g	
200078617	300184411	V 1A-2	U	0.25	0.03	ug/g	
200078618	300184414	V 1A-3	U	0.53	0.05	ug/g	
200078619	300184417	V 1B-1	U	0.74	0.07	ug/g	
200078620	300184419	V 1B-2	U	0.35	0.04	ug/g	
200078621	300184423	V 1B-3	U	0.31	0.03	ug/g	
200078622	300184426	V 2-1	U	3.07	0.31	ug/g	
200078623	300184429	V 2-2	U	0.64	0.06	ug/g	
200078624	300184432	V 2-3	U	0.59	0.06	ug/g	
200078625	300184435	V 3A-1	U	0.51	0.05	ug/g	
200078626	300184438	V 3A-2	U	0.61	0.06	ug/g	
200078627	300184441	V 3A-3	U	0.41	0.04	ug/g	

**** FINAL REPORT ****

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Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100033332

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200078632	300184444	U	0.40	0.04	ug/g	0.41	0.041	ug/g	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38058	300198433	U	10.56	1.06	ug/L	10.1	1.0	ug/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: GENERIC KPA **Method Area:** EH-ALPHA **Submission Id :** 100033343

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	08-JAN-99
Requester Group:	ESH-20	**Logged Date:**	28-OCT-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	667-0815			**Logged by:**	APODACA
Requester Fax #:	667-0731	**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200078652	300184491	V 3B-1	U	1.21	0.12	ug/g	
200078659	300184494	V 3B-2	U	1.06	0.11	ug/g	
200078660	300184497	V 3B-3	U	0.89	0.09	ug/g	
200078661	300184500	V CV-1	U	0.27	0.03	ug/g	
200078662	300184502	V CV-2	U	0.30	0.03	ug/g	
200078663	300184506	V CV-3	U	0.20	0.02	ug/g	
200078664	300184509	V GS-1	U	0.29	0.03	ug/g	
200078665	300184512	V GS-2	U	1.00	0.10	ug/g	
200078666	300184515	V GS-3	U	0.66	0.07	ug/g	
200078667	300184518	V JS-1	U	1.51	0.15	ug/g	
200078668	300184521	V JS-2	U	0.50	0.05	ug/g	
200078669	300184524	V JS-3	U	0.80	0.08	ug/g	

**** FINAL REPORT ****

Method: GENERIC KPA Method Area: EH-ALPHA Submission Id : 100033343

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200078683	300184527	U	0.33	0.03	ug/g	0.31	0.031	ug/g	IN CONTROL

OPEN QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.38058	300198434	U	10.33	1.03	ug/L	10.1	1.0	ug/L	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: GENERIC MOISTURE **Method Area:** EH-ALPHA **Submission Id :** 100032167

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073830	300175325	1BBN-1	MOISTURE	8.50	0.40	%	
200073831	300175330	1BBN-2	MOISTURE	7.10	0.40	%	
200073832	300175335	1BBN-3	MOISTURE	5.70	0.30	%	
200073833	300175340	2BN-1	MOISTURE	11.10	0.60	%	
200073834	300175345	2BN-2	MOISTURE	13.30	0.70	%	
200073835	300175350	2BN-3	MOISTURE	15.80	0.80	%	
200073836	300175355	3ABN-1	MOISTURE	5.50	0.30	%	
200073837	300175360	3ABN-2	MOISTURE	4.50	0.20	%	
200073838	300175365	3ABN-3	MOISTURE	4.60	0.20	%	
200073839	300175368	3BBN-1	MOISTURE	5.40	0.30	%	
200073840	300175375	3BBN-2	MOISTURE	4.80	0.20	%	
200073841	300175380	3BBN-3	MOISTURE	4.10	0.20	%	
200073842	300175385	JSAM	MOISTURE	13.50	0.70	%	
200073843	300175390	JSBN	MOISTURE	21.80	1.10	%	
200073844	300175395	CAM	MOISTURE	4.70	0.20	%	
200073845	300175400	CBN	MOISTURE	9.10	0.50	%	
200073846	300175405	GSN	MOISTURE	8.30	0.40	%	

**** FINAL REPORT ****

Method: GENERIC MOISTURE Method Area: EH-ALPHA Submission Id : 100032167

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073849	300175410	MOISTURE	4.80	0.20	%	4.76	0.43	%	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300177559	MOISTURE	0.00	0.05	%	0.0	0.0	%	IN CONTROL

**** FINAL REPORT ****

LOS ALAMOS NATIONAL LABORATORY
CST Analytical Chemistry
Analytical Results Report

Method: GENERIC MOISTURE **Method Area:** EH-ALPHA **Submission Id :** 100032162

Requester Name:	GIL GONZALES	**Customer Cost Code:**	6E3300M34A02012A00	**Due Date:**	17-NOV-98
Requester Group:	ESH-20	**Logged Date:**	16-SEP-1998	**Screening Data:**	NO SCREENING DATA REQUIRED
Mail Stop:	M887	**Study:**	ESH20 BIOLOGICALS		
Requester Phone:	665-9876			**Logged by:**	LBRANCH
Requester Fax #:		**Analytical Service Agreement #:**			

CUSTOMER SAMPLES

Sample Id	Task Id	Customer Id	Component	Result Value	Uncertainty	Units	Qualifier
200073783	300175613	1AAM-1	MOISTURE	3.80	0.20	%	
200073784	300175615	1AAM-2	MOISTURE	5.60	0.30	%	
200073785	300175614	1AAM-3	MOISTURE	4.00	0.20	%	
200073786	300175616	1BAM-1	MOISTURE	6.80	0.30	%	
200073787	300175617	1BAM-2	MOISTURE	4.50	0.20	%	
200073788	300175618	1BAM-3	MOISTURE	6.00	0.30	%	
200073789	300175619	2AM-1	MOISTURE	4.20	0.20	%	
200073790	300175620	2AM-2	MOISTURE	3.70	0.20	%	
200073791	300175621	2AM-3	MOISTURE	2.90	0.10	%	
200073792	300175624	3AAM-1	MOISTURE	6.30	0.30	%	
200073793	300175625	3AAM-2	MOISTURE	2.60	0.10	%	
200073794	300175626	3AAM-3	MOISTURE	1.90	0.10	%	
200073795	300175622	3BAM-1	MOISTURE	8.80	0.40	%	
200073796	300175623	3BAM-2	MOISTURE	3.40	0.20	%	
200073797	300175627	3BAM-3	MOISTURE	5.80	0.30	%	
200073798	300175628	1ABN-1	MOISTURE	8.60	0.40	%	
200073799	300175629	1ABN-2	MOISTURE	5.60	0.30	%	
200073800	300175630	1ABN-3	MOISTURE	3.40	0.20	%	

****** FINAL REPORT ******

Method: GENERIC MOISTURE Method Area: EH-ALPHA Submission Id : 100032162

********** CST QUALITY ASSURANCE REPORT **********

BLIND QC

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
200073801	300175280	MOISTURE	4.00	0.20	%	3.85	0.35	%	IN CONTROL

METHOD BLANK

Customer Id	Task Id	Component	Result Value	Uncertainty	Units	QC Value	QC Uncertainty	QC units	QC Evaluation
00.22776	300177558	MOISTURE	0.00	0.05	%	0.0	0.0	%	IN CONTROL

**** FINAL REPORT ****

Lance Steere/Taragon Analytics, Inc.
225 Commerce Drive
Fort Collins CO 80524

Colorado State University
Soil, Water and Plant Testing Laboratory
Natural & Environmental Sciences Bldg - A319
Fort Collins, CO 80523

(970) 491-5061 FAX: 491-2930

DATE RECEIVED: 11-16-1998
DATE REPORTED: 12-17-1998

BILLING:

RESEARCH SOIL ANALYSIS

Lab #	Sample ID#	paste pH	paste EC mmhos/cm	Lime Estimate	% OM	AB-DTPA Extract ppm NO_3-N	P	K	Zn	Fe	Mn	Cu
R2436	2000077757 01	8.2	0.6	Low	0.6	1.6	2.1	177	1.29	8.75	17.4	2.30
R2437	2000077758 02	7.8	0.8	Low	1.0	7.4	7.1	277	3.88	6.91	5.18	1.87
R2438	2000077759 03	7.5	0.8	Low	1.1	9.4	4.7	308	0.57	7.64	2.95	2.02
R2439	2000077760 04	8.2	1.0	Low	0.9	6.0	4.8	188	1.02	6.15	3.58	1.86
R2440	2000077761 05	8.0	0.6	Low	0.5	4.5	2.5	89.3	0.84	3.98	2.29	1.45
R2441	2000077762 06	7.4	0.8	Low	3.6	14.5	61.8	409	2.74	10.0	4.64	2.25
R2442	2000077763 07	7.8	1.2	High	4.2	20.3	43.5	954	1.75	12.0	5.80	2.76
R2443	2000077764 08	7.1	0.7	Low	7.1	12.3	6.4	143	7.15	79.4	8.26	1.92
R2440	DUPLICATE	8.0	0.6	Low	[illegible]							
R2443	DUPLICATE	[illegible]		Low	7.1	12.8	6.8	153	7.50	81.0	8.18	1.90
check	analyzed	7.7	0.2	[illegible]	2.2	24.7	14.4	325	4.30	95.9	35.4	4.83
check	expected	7.7	0.2	[illegible]	2.2	25.1	13.4	338	4.19	100	31.6	4.94

Lab #	Sample ID #	Exchangeable Bases meq/100g Ca	Mg	Na	K	% Sand	Silt	Clay	Texture	meq/100g CEC
R2436	2000077757 01	3.83	0.47	<0.1	0.30	65	27	8	Sandy Loam	3.2
R2437	2000077758 02	5.62	0.98	0.1	0.34	64	28	8	Sandy Loam	9.9
R2438	2000077759 03	9.94	1.72	<0.1	0.74	54	33	13	Sandy Loam	12.3
R2439	2000077760 04	6.00	0.93	0.1	0.43	62	30	8	Sandy Loam	7.1
R2440	2000077761 05	4.13	0.47	0.1	0.17	69	25	6	Sandy Loam	3.9
R2441	2000077762 06	12.4	3.17	<0.1	1.49	48	36	16	Loam	20.7
R2442	2000077763 07	16.9	3.16	<0.1	3.67	53	24	23	Sandy Clay Loam	25.0
R2443	2000077764 08	11.1	0.76	<0.1	0.46	50	39	11	Loam	17.6
R2440	DUPLICATE	3.65	0.41	0.1	0.25	67	27	6	Sandy Loam	4.1
check	analyzed	8.41	1.89	0.4	0.61	58	24	18	Sandy Loam	16.9
check	expected	8.56	2.01	0.4	0.68	59	25	16	Sandy Loam	17.1

Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545

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